



State of Utah

JON M. HUNTSMAN, JR.
Governor

GARY R. HERBERT
Lieutenant Governor

Department of Administrative Services

KIMBERLY K. HOOD
Executive Director

Division of Facilities Construction and Management

DAVID G. BUXTON
Director

ADDENDUM #2

Date: 3 April 2008

To: Contractors

From: Matthias Mueller, Project Manager

Reference: Utah National Guard
Readiness Center – CM/GC
DFCM Project No. 04188470

Subject: **Addendum No. 2**

Pages	Addendum	1	page
	GSBS Addendum No. 2	19	pages
	Revised Cost Proposal Form	5	pages
	Specifications & Drawings	287	pages
	Response to Questions	3	pages
	Total	315	pages

Note: This Addendum shall be included as part of the Contract Documents. Items in this Addendum apply to all drawings and specification sections whether referenced or not involving the portion of the work added, deleted, modified, or otherwise addressed in the Addendum.

- 2.1 **SCHEDULE CHANGES** – There are no changes to the project schedule per addendum #2.
- 2.3 See attached:
GSBS Addendum No. 2, dated April 3, 2008.
Revised Cost Proposal (5 pages)
Specification & Drawings
Response to Questions

End of Addendum #2



DFCM

Division of Facilities Construction and Management
4110 State Office Building Salt Lake City, UT 84114
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ADDENDUM NO. 2
April 3, 2008

Readiness Center & Civil Support Team Building
North Salt Lake, Utah

The original specifications and drawings, dated February 1, 2008 for the project referenced above are amended in the Addendum No. 2, dated April 3, 2008.

Receipt of this addendum shall be acknowledged by inserting its number and date in the space provided on the bid form.

This addendum consists of the following:

ARCHITECTURAL ADDENDUM ITEMS:

AD2-A01 Specification 012300 Alternates, Paragraph 3.1 (C):

Change Alternate No. 3: Delete last two sentences, as follows:

Alternate No. 3: Provide direct evaporative cooling sections in AHU-3 through AHU-5, as described on mechanical sections. Also, provide water and drain piping as shown on plumbing plans. ~~Delete the furring and insulation on the interior walls around the Assembly Hall, Unit Storage for CRT and the Maintenance Work Bays, Rooms # 109, 114, 115, 119 and 121. Also delete the insulation on the ceilings (bottom of second floor) of the Unit Storage areas, Rooms # 103, 104, 105, 106, 107, 108, 112, 113, 114, 115, 117, 118, 119 and 121.~~

AD2-A02 Request For Proposals, Page 16:

Replace the Cost Proposal Form (2 pages) with the Attached AD2-A02 Cost Proposal Form (5 pages.)

AD2-A03 Sheet AE501:

Add attached AD2-A03 Exterior Finish Schedule. Clarification of exterior finishes.

AD2-A04 **Various Specification Sections:** Add approved manufacturer to specifications:

074213 Metal Wall Panels, Paragraph 2.5.B.1:
f. Englert Inc.

087100 Door Hardware, Paragraph 2.1.A.3:
d. Dorma, Dorma Architectural Hardware

087100 Door Hardware, Paragraph 2.1.A.5:
d. Dorma, Dorma Architectural Hardware

101100 Visual Display Surfaces, Paragraph 2.1.A.1:
c. Aarco Products Inc.

101100 Visual Display Surfaces, Paragraph 2.2.A.1.h, 2.3.A.13,2.5.A.1.j
Newline Products Inc.

101400 Signage 2.4.A Panel Signs:
2. Advance Corporation; Braille-Tac Division.
3. APCO Graphics, Inc.
4. ASI-Modulex, Inc.
5. Best Sign Systems Inc.
6. Innerface Sign Systems, Inc.
7. Mohawk Sign Systems.
8. Seton Identification Products.

102113 Toilet Partitions, Paragraph 2.1.A:
23. American Accessories Inc.

102213 Wire Mesh Partitions, Paragraph 2.1.A:
11. Standard Wire & Steel Works, South Holland, Illinois.

102226 Operable Panel Partitions, Paragraph 2.1.A:
4. Moderco Partitions- Signature Series 8500 and 8555 Paired Panels

102800 Toilet and Bath Accessories, Paragraph 2.1.A.1:
d. American Accessories Inc.

105113 Metal Lockers, Paragraph 2.1.A:
15. ASI Storage Solutions.

122413 Roller Window Shades 2.1.A:
2. Skyco Shading Systems

AD2-A05 Specification Section 075423 Thermoplastic Membrane Roofing,
Paragraph 2.4: Add R-Value to specifications as follows:

E. Rigid Insulation R-Value: R-30 Minimum.

AD2-A06 Window Sills:

Sheet AE602: Add Detail AD2-A06 Window Sill Detail A1/AE603.

Specification 064023 Interior Architectural Woodwork:

Paragraph 1.2.A - Add:

3. Solid-Surfacing-material window sills

Paragraph 2.2 - Add:

- I. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Corian; DuPont Polymers.
 - b. Himacs, Inc.
 - c. Pre-approved Equal
 2. Type: Standard type, unless Special Purpose type is indicated.
 3. Colors and Patterns: As selected by Architect from manufacturer's full range.

Add Paragraph 2.6:

2.6 SOLID-SURFACING-MATERIAL WINDOW SILLS

- A. Quality Standard: Comply with AWI Section 400 requirements for countertops.
- B. Solid-Surfacing-Material Thickness: 1/2 inch. See details in construction drawings.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. Architect to select from manufacturer's full product line.
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
1. Fabricate tops with shop-applied edges of materials and configuration indicated.

AD2-A07 **Specification 101400 Signage, Modify and add to Paragraph 2.2 (C):**

- C. Plaque Schedule - Logo
1. Plaque Type: Custom - Utah National Guard Logo, See Attachment.
 - a. Plaque Size: 36" diameter.
 - b. Color: Flag to be painted Red, White and Blue.
 - c. Text/Message: Utah National Guard Logo.
 - d. Location: As indicated on plans.
 2. Room: Hall 101A
 3. Quantity: One
- D. Plaque Schedule - Dedicatory Plaque
1. Plaque Type: Bronze with Raised Letters and contrasting background.
 - a. Plaque Size: 36" wide x 24" tall.
 - b. Color: Manufacturer's Standard.
 - c. Text/Message: DFCM Standard Building Plaque.
 - i. All final titles, names, etc. will be provided by the Owner.
 - ii. Project Title centered in 7/8" capital Century Gothic style lettering.
 - iii. The State Seal shall be placed at 4" to center from the upper left corner of the plaque, and 3/4" below the top edge. Recommended size of the seal is 4" diameter.
 - iv. The dedication date shall be included in the bottom center of the plaque in 5/8" capital Century Gothic style lettering in the following format:: DEDICATED MONTH 20XX.
 - v. The Governor's name shall be placed at the top, following the title.
 - vi. Executive Directors of DAS and the Utah National Guard shall be listed, per DFCM Standard Building Plaque guidelines.
 - d. Location: Exact location to be determined.
 2. Room: Hall 101A
 3. Quantity: One

AD2-A08 **Sheets AE111 and AE 112 - Clarification of Finishes on Walls:**

All walls (CMU and Gypsum Board) in Restrooms, above and to the sides of scheduled tile walls: Use epoxy paint per attached Specification 099600 High Performance Coatings.

All walls (CMU and Gypsum Board) in all Kitchen Areas: Use epoxy paint per attached Specification 099600 High Performance Coatings.

All other CMU walls: Integral color CMU is to be used in all other locations scheduled to have CMU walls.

AD2-A09 **Specification 1057500 Decorative Formed Metal** (Issued in Addendum No. 1):

Add the following Paragraphs:

(A) Section Includes

4. High-Performance Coatings on Exterior Sunshades

2.4 PAINTS AND COATINGS

A. SCHEDULE OF COATING SYSTEMS

1. Exterior Exposed Steel:

- a. Surface Preparation: Brush-Off Blast to provide a minimum 1.0 mils profile. Substrate must be clean, dry, and free of contaminants.
- b. Primer: *Tnemec Series N69/V69 Epoxoline, or approved equal, at 2.0 to 3.0 mils DFT.
- c. Finish Coat: Tnemec Series 1070 Fluoronar, or approved equal at 2.0 to 3.0 mils DFT.
- d. Total Dry Film Thickness: 4.0 to 6.0 mils.

* Primer should be in the same color family as the finish coat (within 1-2 shades lighter)

3.3 SURFACE PREPARATION AND TOUCH-UP

2. Steel: Clean surfaces free of residual deposits of grease, rust, scale, dirt, dust, and oil.

Surface Preparation:

- a. (Shop or Field) Prepare in accordance with SSPC-SP7 Brush-Off Blast Cleaning standards.

- b. (Field Touch-up of Shop-applied Products)
Clean rusted and bare metal areas in accordance with SSPC-SP11 Power Tool Cleaning to Bare Metal or SSPC-SP7 Brush-Off Blast Cleaning standards.

AD2-A10 **Specification 013300 Submittal Procedures, Paragraph 1.3(B):** Add the following requirements:

- 2. Submittals Schedule: Submittals shall be delivered to the Architect for review in a timely manner, sufficient to allow for their review and the ordering, fabrication, deliver, installation, etc. at the job site.
 - a. Submittals shall be submitted within the following time periods, in calendar days from the Notice to Proceed:

60 Days	Structural, Underground Mechanical and Electrical, Masonry, Civil
90 Days	Doors, Frames, Hardware, Windows, Storefront
120 Days	Roofing, Electrical Fixtures, Mechanical Equipment, Plumbing Fixtures
150 Days	Finishes
180 Days	Landscaping and all remaining submittals
 - b. Should the Contractor fail to deliver submittals as outlined, there shall be deducted from any amount due or that may become due the Contractor, a sum of **\$100.00** per day, per submittal for each and every day beyond the maximum number of days listed above. Such sum is fixed and agreed upon by the DFCM and Contractor as liquidated damages due the DFCM by reason of the inconvenience and added costs of administration, engineering, supervision and other costs resulting from the Contractor's default, and not as a penalty.

AD2-A11 **Stair and Landing Details - Eliminate Tripping Hazards:**

See attachments in AD2-A11:
AD02-A11a Detail D6/AE412
AD02-A11b Detail D6/AE411
AD02-A11c Detail E3/AE411
AD02-A11d Detail C6/AE411
AD02-A11e Detail B6/AE411
AD02-A11f Detail A6/AE411

- AD2-A12 **Specification Section 014000 Quality Requirements, Paragraph 1.3(C):**
Add the following requirements:
- (1) Mockups for the building exterior finishes, including architectural precast, brick masonry, windows, flashing, etc. shall be placed at the site within 90 days from the Notice to Proceed. The approved mockups shall remain in place throughout construction and shall be the basis of minimum acceptance quality.
 - (2) Mockups for the building interior finishes, including flooring, wall surfaces, ceilings, light fixtures, etc. shall be placed prior to commencement of interior finishes. Such mock up may be a specific room in the building, and may remain at the end of the project. The approved mockups shall remain in place throughout construction and shall be the basis of minimum acceptance quality.

- AD2-A13 **Specification Section 142400 Hydraulic Elevators:** Add the following requirements:
- 1.8 COORDINATION
 - A. Bidders shall review all Construction Documents related to the construction and coordination of the elevator system prior to submitting a bid.
 - 1. If space for accommodating a specific elevator system, including size of hoistway, size of equipment room, pit depth, clear overhead space, elevator doors, equipment room doors, etc., is not sufficient as indicated, the Contractor shall include in their bid any and all costs for modifications necessary to accommodate the elevator system.
 - 2. If other requirements for accommodating a specific elevator system, including electrical power, ventilation, spill containment, pit base/footing, reinforcing, etc., is not sufficient as indicated, the Contractor shall include in their bid any and all costs for modifications necessary to accommodate the elevator system.
 - B. Forming and placement of concrete and reinforcement for footing of elevator pit shall not occur until submittals for the elevator has been reviewed.

AD2-A15 **Specification Section 099100 Painting:** Add the following requirements:

Add to Paragraph 2.5:

- G. Epoxy Block Filler: MPI #116.
- 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cloverdale Paint; Epoxy Block Filler, 83065.
 - b. Coronado Paint; Polyamide Epoxy Block Filler, 101-11.
 - c. Diamond Vogel Paints; V-Cote 100, Acrylic Epoxy Block Filler, MC-1234.
 - d. Frazee Paint; Ameron, Amerlock 400 BF, 400 BF.
 - e. General Paint; Ameron, Amerlock Block Filler, 400BF.
 - f. Miller Paint; PPG Aquapon, Polyamide Epoxy Block Filler, 97-685 Series.
 - g. PARA Paints; Insl-x, Epoxy Blockfiller, EXP 120.
 - h. Parker Paint Mfg. Co. Inc.; Ameron, Amerlock 400 BF, 400BF.
 - i. PPG Architectural Finishes, Inc.; Aquapon, Epoxy Block Filler, 97-685.
 - j. Rodda Paint Co.; Carboline, Carboguard 954HB.
 - k. Sherwin-Williams Company (The); Industrial & Marine, Kem Cati-Coat HS Epoxy Filler/Sealer, B24W400/V400 S.
 - l. Spectra-Tone; Insl-x, Epoxy Block Filler, EXP 120.

Add the following Paragraph:

2.8 EPOXY COATINGS

- A. Water-Based Epoxy (Interior and Exterior): MPI #115.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Benjamin Moore & Co.; Acrylic Epoxy Gloss "A", Hardener "B", M43/M44.
 - b. BLP Mobile Paint Manufacturing Company, Inc.; Mo-PoxY H2O-200; Waterborne Epoxy -White, 69-AW-6.
 - c. California Paints; H. P. Industrial, Tuf-Flex Acrylic Epoxy Water Base En, 13XX-Series.
 - d. Cloverdale Paint; EcoLogic Water-Borne Epoxy, 705 Series.
 - e. Color Wheel Paints & Coatings; Contractor's Choice, Clean-Coat Aqua Epoxy, 1300.

- f. Columbia Paint & Coatings; Dupont, Corlar Waterborne Acrylic Epoxy, 76P.
- g. Coronado Paint; Water-Based Amine Adduct Epoxy, 142 Line.
- h. Diamond Vogel Paints; Aqua Pox, Waterborne Epoxy, MC-1245/6.
- i. Dunn-Edwards Corporation; Intergard 735, 73510.
- j. Farrell-Calhoun; Tuff-Boy, Waterborne Epoxy, 1200 WB.
- k. Frazee Paint; Epox-Z-Cote Gloss, 547.
- l. General Paint, Ameron; Amercoat 335, 96 Line.
- m. Griggs Paint; Hydropox #2 Waterborne Epoxy Coating, 600V03.
- n. ICI Paints; Devoe/Fuller, Gardcote-WB, DP25U9XX.
- o. Insl-x; AllPro, Pro Water Based Epoxy, AP4300-12231.
- p. Iowa Paint Manufacturing Company, Inc.; W. B. Acrylic Epoxy Gloss, 18939.
- q. Kelly-Moore Paints; Envira-Poxy, 7100.
- r. Miller Paint; Waterborne Epoxy Gloss, 4300/4440.
- s. PARA Paints; Insl-x Aqua-Tile Epoxy, ATA-100.
- t. Parker Paint Mfg. Co. Inc.; Ameron, Amercoat 335, 335.
- u. Porter Paints; Dura-Glaze WB, Gloss Epoxy, 9371.
- v. PPG Architectural Finishes, Inc.; Aquapon, Waterborne Epoxy, 98-1/98-98.
- w. Rodda Paint Co.; Professional Maintenance, Aqua-Flint, 559201X.
- x. Sherwin-Williams Company (The); Industrial & Marine, Water Based Catalyzed Epoxy, B70W Series.
- y. Sico, Inc.; Rust-Oleum, Acrylic Epoxy, 5300 Series.
- z. Spectra-Tone; Insl-x Aqua-Tile W.B. Epoxy, ATA 100 Series.
- aa. Tower Paint, Sierra, Wall & Trim Enamel, S50.

AD2-A16 **Add Specification 033300 Architectural Concrete:**

All exposed concrete walls shall be Architectural Concrete per the Attached specification. This includes the walls of the Vaults.

AD2-A17 **Specification Section 014000 Quality Requirements (and all Specifications)**

Clarification: ALL INSPECTIONS AND TESTING WILL BE ENGAGED AND PAID FOR BY THE GOVERNMENT. Contractor shall remain responsible for re-testing should the contractor fail the test by the government.

- AD2-A18 **Specification Section 018113 - Sustainable Design Requirements**
- Add to Paragraph 1.5 Quality Assurance
- B. This project will NOT be submitted to the USGBC. Rather, the Utah National Guard, the Architect and the Contractor shall jointly review the LEED Documentation and Score, Evaluate and Certify the building to be the equivalent of LEED Silver using the LEED Checklist 2.2 for New Construction.
- AD2-A19 **Sheets AE121, AE122 and AE 123 Reflected Ceiling Plans**
- Plan Legend: Delete references to ceiling Type J: Lead Lined Ceilings. There is no such ceiling in this project.
- AD2-A20 **Specification 012100 Allowances, Paragraph 3.3, Add:**
- B. Allowance No. 2: \$25,000 for exterior signage, which may include a Pylon Sign, Dimensional Characters on the building, or other signage to be determined by the Utah National Guard.
- AD2-A21 **Specification 107300, Change Paragraph 2.04:**
- C. All exposed Aluminum finish shall be **clear anodized**.
- Note that the Cable Suspension System is NOT the standard system by the translucent panel manufacturer. This system must be designed to accommodate the Cable Suspension system.
- AD2-A22 **Specification Section 101100 Visual Display Surfaces**
- Delete Paragraph 2.4 Rail Support System for Visual Display Boards and Paragraph 2.5 Sliding Visual Display Units.
- AD2-A123 **Specification 013200 Construction Progress Documentation, Paragraph 2.5 (F)**
- On a monthly basis the Contractor shall indicate the ORIGINAL schedule to compare with all changes and deviations.
- On a weekly basis the Contractor shall provide an updated CPM Schedule and a 4-6 week look-ahead, including the ordering of long-lead materials.

AD2-A24 Specification 013100 Project Management and Coordination, Paragraph 1.5: Add the following requirement.

B. The Project Superintendent shall remain on-site until all construction activities are completed, including resolution to the Correction List from the Final Inspection.

CIVIL ADDENDUM ITEMS

AD2-C01 Add the following specification sections (see attachment):

Division 31- Earthwork

311000- Site Preparation

312200- Grading

312300- Trench Excavating, Backfilling and Compaction

Division 32-Exterior Improvements

321123- Base Course

321216- Asphaltic Concrete Paving

321613- Curbs, Gutters, Drive Aprons and Walks

323113- Chain Link Fence and Gates

Division 33- Utilities

330525- Restoration of Existing Improvements

331100- Potable Water Distribution Systems

331300- Disinfection of water distribution systems

333100- Sanitary Sewer Systems

334100- Storm Sewage Systems

335113- Gas Distribution System

MECHANICAL ADDENDUM ITEMS:

AD2-M01 Sheet MH101:

Shifted 46/18 & 34/18 ducts to align with shaft above column Line D. See Attachment AD2-M01 MH101.

AD2-M02 Sheet MH102:

Added new RTU-1 Penetrations thru the roof and connections into shaft. See Attachment AD2-M02 MH102.

AD2-M03 Sheet MH103:

Moved location of RTU-1. See Attachment AD2-M03 MH103.

AD2-M04 Sheet PL101:

Added Floor Cleanout. See Attachment AD2-M04 PL101

AD2-M05 Sheet PL401:

Added wall cleanout at urinal bank. Moved wall cleanout at water closets into plumbing chase. Changed the floor cleanout next to doorway to a wall cleanout in the stairwell. See Attachment AD2-M05 PL401.

AD2-M06 Sheet PL402:

Added wall cleanout at Urinal bank and in the plumbing chase. See Attachment AD2-M06 PL402.

AD2-M07 Replace the following specification sections (see attachment):

230500	Basic Mechanical Requirements
230529	Basic Mechanical Materials and Methods
230900	Electronic Controls

ELECTRICAL ADDENDUM ITEMS:

- AD2-E01 Specification 283111 Digital, Addressable Fire-Alarm System
Specifications section added. See attached
- AD2-E02 Specification 260943 Network Lighting Controls
Specifications section added. See attached
- AD2-E03 Specification 262713 Electricity Metering
Add to approved manufacturers: Cutler Hammer
(Note that it is preferred but not required that the Digital Meters in the branch Panelboards be mounted in the panelboards. If meters mounted outside the branch panelboards are provided, it is required that the contractor verify there is enough space in the electrical room to mount them. It is required to mount the digital meter shown in the Main Distribution Switchboard "MDSB" in the switchboard)
- AD2-E04 Specification 264113 Lightning Protection for Structures
Add to approved manufacturers:
1. Preferred Lightning Protection
2. VFC, Inc.
- AD2-E05 Specifications
The following specifications are being replaced. See the attached specifications.
1. 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
2. 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
3. 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS
4. 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
5. 262413 - SWITCHBOARDS
6. 262416 - PANELBOARDS
7. 262726 - WIRING DEVICES
8. 263213 - ENGINE GENERATORS
9. 271000 - COMMUNICATIONS STRUCTURED CABLING
- AD2-E06 Sheet ES101:
1. Add 2-each OE-7 light fixtures at the flag pole lights. That makes a total of (4) OE-7 light fixtures at that location. The fixtures shall be mounted between the flag poles and on the ends of the flag poles. They shall all be controlled on the same relay with the existing flag pole lights.

AD2-E07

Sheet EP102:

2. Panel 2HA is to be located on the west wall of ELEC. 221.

AD2-E08

Sheet EP601:

1. Between the building transformer and the main switchboard, provide conduit only. Conductors are to be provided by Rocky Mountain Power.
2. Between the utility connection and the transformer (the primary feeder conduit), provide a 6-inch conduit instead of a 5-inch conduit.
3. See the following table for short circuit ratings of the panels.

FAULT CURRENT TABLE	
BUS	FAULT CURRENT
1DPLA	9,850 SCA
1HA	25,010 SCA
1LA	9,380 SCA
1LB	8,730 SCA
1LC	4,467 SCA
1LD	4,467 SCA
1MHA	24,913 SCA
1MLA	6,179 SCA
2HA	9,255 SCA
2HB	18,237 SCA
2LA	5,964 SCA
2LB	5,862 SCA
2LC	7,447 SCA
CSTDPLA	7,523 SCA
EMDPHA	23,194 SCA
EMHA	22,704 SCA
EMLA	1,867 SCA
K	6,695 SCA
MDPHA	25,389 SCA
MDSB	26,392 SCA
MSB	30,748 SCA
UHB	2,015 SCA
PROVIDE FULLY RATED CIRCUIT BREAKERS IN PANELBOARDS FOR THE FAULT CURRENT SHOWN. SERIES RATINGS WITH NEXT LEVEL UPSTREAM OVERCURRENT PROTECTIVE DEVICES ARE PERMITTED SUBJECT TO FACTORY UL DOCUMENTATION OF SERIES RATING SUBMITTED TO ENGINEER. IF DEVICE OR EQUIPMENT FAULT CURRENT RATING IS NOT SHOWN, ASSUME 100,000 AIC.	

4. Change the conduit and conductor size callout for the feeder to panel 2HB from #33 to #36 (on both sides of the junction box).

AD2-E09

Sheet EL101:

1. Physical Fitness 151: All fixtures in this room shall be GS-99 (dual-level switched).
2. Break 132: All fixtures in this room shall be GS-99 (dual-level switched).

AD2-E10

Sheet EL601:

1. Add light fixture GS-5 under the GS fixture column.

2X4, 4 LAMP. PROVIDE (2) BALLASTS FOR DUAL- LEVEL SWITCHING, 277/120V, 120W, 4-F32T8, RE835	LITHONIA	2 SP8G 432 A12125 1/4 MVOLT TUBRHP (4-1/2" DEPTH)
	METALUX	2GP-432A125-UNV-EB81-PROGRAM START (3-3/4" DEPTH)
	DAYBRITE	2DPG432-FS21-UNV-1/4EB-SPEC (4-3/8" DEPTH)
	LSI	LA125 432 SD SSO10PS UE (4" DEPTH)
	LIGHTOLIER	XT2GVI432-UNV-04P (3-5/8" DEPTH)
	COLUMBIA	ST824-432G-FSA12.125-4EB8LHPRUNV (3-3/4" DEPTH)

2. Prior approved equal light fixtures:
 - a. EP-1: Guth #VPW-100IGHL
 - b. EM: Lightguard FLTC
 - c. OC-27: Deco #D443-150-M-WT-MT-SCBA
 - d. OC-32: Deco #D444-142-C-EB-SCBA-MT-SCBA
 - e. S-1: LSI #S-1-32-SSOR-U-UE
 - f. SA-1: LSI #F-20-2-32-SSOR-U-UE

AD2-E11

Sheet ET102:

1. In Learning Center 218 and Conference 245 there is only 1 floor box "FB". Provide 2 each data terminations and 1 each voice termination to each floor box.light fixture GS-5 under the GS fixture column.

AD2-E12

Sheet ET601:

Add the following Audio/Video Cable Schedule

AUDIO/VIDEO CABLE SCHEDULE			
CABLE TYPE	DESCRIPTION	ACCEPTABLE TYPES	SPECIAL INSTRUCTIONS
M	MICROPHONE CABLE, 22 AWG, SHIELDED, TWISTED PAIR W/ DRAIN	BELDEN 8451 WEST PENN CL2 452 CANARE L-4E5AT	PROVIDE PLENUM RATED CABLE IN ALL AIR PLENUMS
L	LINE LEVEL CABLE, 22 AWG, SHIELDED, TWISTED PAIR W/ DRAIN	BELDEN 8451 WEST PENN CL2 452 CANARE L-4E5AT	PROVIDE PLENUM RATED CABLE IN ALL AIR PLENUMS
S	SPEAKER CABLE, 70 V, 16 AWG, TWISTED PAIR	BELDEN 8471 WEST PENN CL2 225 CANARE 458	PROVIDE PLENUM RATED CABLE IN ALL AIR PLENUMS
V	VIDEO CABLE, 75 OHM, COAXIAL, RG 59	BELDEN 8221 WEST PENN 814 CANARE L-5CFB	PROVIDE PLENUM RATED CABLE IN ALL AIR PLENUMS
Y	S-VIDEO CABLE (YC), 2 COAXIAL, HIGH RESOLUTION	EXTRON S-VIDEO CABLE, TWO CONDUCTOR LIBERTY SV-PVC	PROVIDE PLENUM RATED CABLE IN ALL AIR PLENUMS
R	RGBHV CABLE, 5 COAXIAL, HIGH RESOLUTION	EXTRON SHR-5 CANARE V5-5CFB	PROVIDE PLENUM RATED CABLE IN ALL AIR PLENUMS
C	CONTROL CABLE, 24 AWG, 4 PAIR, OVERALL SHIELD	BELDEN 8104 WEST PENN D2404	PROVIDE PLENUM RATED CABLE IN ALL AIR PLENUMS
I	DVI-I CABLE	LIBERTY E-DVIDSL-X LIBERTY DVI-P/SL-Fo-XXX	PROVIDE PLENUM RATED CABLE IN ALL AIR PLENUMS
D	DATA CABLE, CATEGORY 6	LIBERTY 24-4P-L6-EN	PROVIDE PLENUM RATED CABLE IN ALL AIR PLENUMS

END OF ADDENDUM

ADDENDUM NO. 2

AD2-16

AD2-A02: COST PROPOSAL FORM

NAME OF PROPOSER _____ DATE _____

To the Division of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

The undersigned, responsive to the "Notice to Contractors" and in accordance with the "Request for Proposals" for the **READINESS CENTER – UTAH ARMY NATIONAL GUARD – SALT LAKE CITY, UTAH – DFCM PROJECT NO. 04188470** and having examined the Contract Documents and the site of the proposed Work and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: _____

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Cost Proposal.

The Cost Proposal shall be for the entire work as designated in the plans and specifications and addenda.

Description of Bid Items and all blank spaces shall be filled in. Failure to bid any item will disqualify the entire bid. Each Proposer shall use this form as furnished or an exact duplicate thereof.

All requested quantities shall be provided by the Proposer.

Payments for work in connection with the construction of the Readiness Center and its appurtenances will be made on the basis of the lump sum bid amount of each item described in the Description of Bid Items.

Description of Bid Items

Note: It is the intent that ALL work shown on the Drawings and described in the Specifications and Contract Documents are covered in the following Bid Items.

The costs following items shall be separated, but comprise the Base Bid. Alternate Bid Items are listed separately after the description of all bid items. The separation of the scope of work to be performed for each bid item listed in the following table will conform to limitations and delineated as follows:

Bid No. 1– Readiness Center and Civil Support Team Building, including all buildings on the site, excluding Alternate Bid Items 1 through 4 listed below. Separate amounts are required for (1) Readiness Center (2) Civil Support Team (3) Controlled Waste Facility and (4) Unheated Storage Building. Refer to the sketch at the end of this attachment for definitions of these Scopes of Work. All work required in connection with construction, including excavation and backfilling for foundation walls and footings, finish shaping and proof rolling subgrade material, engineered fill, and the gravel drainage fill under the floor slab. Utility work will include the installation of all systems within the building and extend to 5 feet outside the building. Mechanical work will include the installation of all heating equipment, ducting, grilles and vent lines. Electrical work will include the installation of all conduit and wiring, fixtures, receptacles and the emergency generator and associated wiring and conduit. Price will include construction of trash enclosure, emergency generator enclosure, transformer enclosure, Controlled Waste Facility, Unheated Storage Building, bollards and parking and traffic signage. This will NOT include foundation piling, soil stabilization, retaining walls, nor any of the work called for by remaining Bid Items.

Bid No. 2 – Site Preparation and Grading: Site Preparation. All work in connection with the preparation of the project site (within the limits of construction) to bring the subgrade elevations required for the construction of facilities to the elevations specified on the plans, including clearing, grubbing, excavation and embankment,

earthwork, drainage channels/systems, retaining walls, and final grading/compaction of site soils to subgrade levels. The bid will NOT include excavation and backfilling required for foundation walls and footing nor the finish shaping and proof rolling of the subgrade under pavements and floor slab construction. Grading. All work in connection with grading of unpaved areas disturbed by construction, including placement of top soil from existing stock piles on the prepared subgrade and finish grading the topsoil. This bid will NOT include sodding, sprigging, mulching, plants, planting, nor the grading and preparation of the subgrade.

Bid No. 3 – Rigid Pavement (Concrete). All work in connection with the furnishing, placing, and compaction of base and surface courses of pavements for access roads, service and access aprons, pads and parking areas, including the finish shaping and proof rolling of the prepared subgrade. This bid will NOT include the construction of prepared subgrade, drainage structures, nor other items designated as site preparation work. The costs for each type parking area and the pavement designated access road are to be indicated separately as listed.

Bid No. 4 – Flexible Pavement (Asphalt). All work in connection with the furnishing, placing, and compaction of base and surface courses of pavements for access roads, service and access aprons, pads and parking areas, including the finish shaping and proof rolling of the prepared subgrade. This bid will NOT include the construction of prepared subgrade, drainage structures, nor other items designated as site preparation work. The costs for each type parking area and the pavement designated access road are to be indicated separately as listed.

Bid No. 5 – Fencing. All work in connection with the furnishing and erection of chain link fencing complete with all posts, fabric, barbed wire barrier, gates, and accessories in place and ready for service.

Bid No. 6 – Sidewalks and Walkways. All work in connection with the construction of concrete walks, including the finish shaping and proof rolling of the prepared subgrade. This bid will NOT include the construction of the prepared subgrade, drainage structures, nor other items designated as site preparation and grading work.

Bid No. 7 – Flagpoles. All work in connection with the furnishing and installation of the flagpole, including rope, foundation, and all accessories complete and ready for service.

Bid No. 8 – Security Lighting. All work in connection with the furnishing and installation of the exterior pole mounted lighting system, including trenching and backfilling, cable, and accessory item to a point 5 feet outside the building line; complete and ready for service. This bid will NOT include work inside the building (5-foot line) nor any building-mounted exterior lighting fixtures.

Bid No. 9 – Utility Connections and Exterior Fire Protection. Utility Connections. All work in connection with furnishing and installing water, gas, and sanitary sewer service lines from the mains to a point 5 feet outside the building line and trenching for direct burial electrical and telephone cables, including backfilling and compaction of earth after cables have been installed by local utility companies. Exterior Fire Protection. All exterior work in connection to provide protection. This includes extension of water mains for fire protection to hydrants. The cost for each type of utility work is to be indicated separately as listed.

Bid No. 10 – Miscellaneous. All work not identified in Bid No. 1 through 9 above. This bid will NOT include work associated with the 4 Alternate Bid Items listed below.

ALTERNATE BID ITEMS:

Alternate Bid Item 1 - Roller Window Shades: All work in connection with furnishing and installing Roller Window Shades in the Assembly Hall, including windows W11 (in the second floor hallways and W12 (in the light monitors). This work will include all associated work, including electrical conduit, wiring and devices.

Alternate Bid Item 2 – Landscaping: All work in connection with grading of unpaved areas. All work in connection with the furnishing and planting of new trees, shrubs, bushes, and vines at locations specified, including fertilization, mulching, staking, erection of temporary barriers to prevent damage, watering and general maintenance operations required to establish healthy growth after transplant. All work in connection with the furnishing of all stone and gravel material. All work in connection with the irrigation system from 5-feet outside of the building.

Alternate Bid Item 3 – Evaporative Cooling: All work in connection with furnishing and installing direct evaporative cooling sections in AHU-3 through AHU-5, as described on mechanical sections. All work in connection with furnishing and installing water and drain piping as shown on plumbing plans.

Alternate Bid Item 4 – Equipment Lockers: All work in connection with furnishing and installing Equipment Lockers as shown in the Equipment Locker Room #155 and as specified.

BID SCHEDULE

<u>Item Description</u>	(by General Contractor)	
	<u>Quantities</u>	<u>Cost</u>
Bid No. 1 – Primary Building and Support Buildings		
a. Readiness Center Building	_____ SF	\$ _____
b. Civil Support Team Building	_____ SF	\$ _____
c. Controlled Waste Handling Facility	_____ SF	\$ _____
d. Unheated Storage Building	_____ SF	\$ _____
SUBTOTAL		\$ _____
Bid No. 2 - Site Preparation and Grading		\$ _____
Bid No. 3 - Rigid Pavement (Concrete):		
a. Access Roads and aprons	_____ SY	\$ _____
b. Military Vehicle Parking (within fenced area)	_____ SY	\$ _____
c. Privately Owned Vehicle Parking (outside fenced area)	_____ SY	\$ _____
d. Pads	_____ SY	\$ _____
SUBTOTAL		\$ _____
Bid No. 4– Flexible Pavement (Asphalt):		
a. Access Roads and aprons	_____ SY	\$ _____
b. Military Vehicle Parking (within fenced areas)	_____ SY	\$ _____
c. Privately Owned Vehicle Parking (outside fenced areas)	_____ SY	\$ _____
d. Pads	_____ SY	\$ _____
SUBTOTAL		\$ _____
Bid No. 5 - Fencing	_____ LF	\$ _____
Bid No. 6 – Sidewalks and Walkways	_____ SY	\$ _____
Bid No. 7 - Flagpoles		\$ _____
Bid No. 8 – Security Lighting		\$ _____
Bid No. 9 - Utility Connections & Exterior Fire Protection:		
a. Water	_____ LF	\$ _____
b. Gas	_____ LF	\$ _____
c. Sewer	_____ LF	\$ _____
d. Electricity	_____ LF	\$ _____
e. Telecommunications and Information Technology	_____ LF	\$ _____
f. Exterior Fire Protection	_____ LF	\$ _____
SUBTOTAL		\$ _____
Bid No. 10 - Miscellaneous		
a. _____	_____	\$ _____
b. _____	_____	\$ _____
c. _____	_____	\$ _____
SUBTOTAL		\$ _____

TOTAL BASE BID \$ _____
(This amount MUST match the written proposal below)

ALTERNATE BID ITEMS:

(1) Roller Window Shades \$ _____
(2) Landscaping \$ _____
(3) Evaporative Cooling \$ _____
(4) Equipment Lockers \$ _____
SUBTOTAL \$ _____

TOTAL BASE BID PLUS ALTERNATE BID ITEMS \$ _____

For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of:

_____ DOLLARS (\$ _____)
(In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete by **October 23, 2009**, should I/we be the successful proposer, and agree to pay liquidated damages in the amount of **\$2,500.00** per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor's Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of _____

The undersigned Contractor's License Number for Utah is _____.

Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in the Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract. The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable 100% Performance and Payment bonds are not delivered within the time set forth.

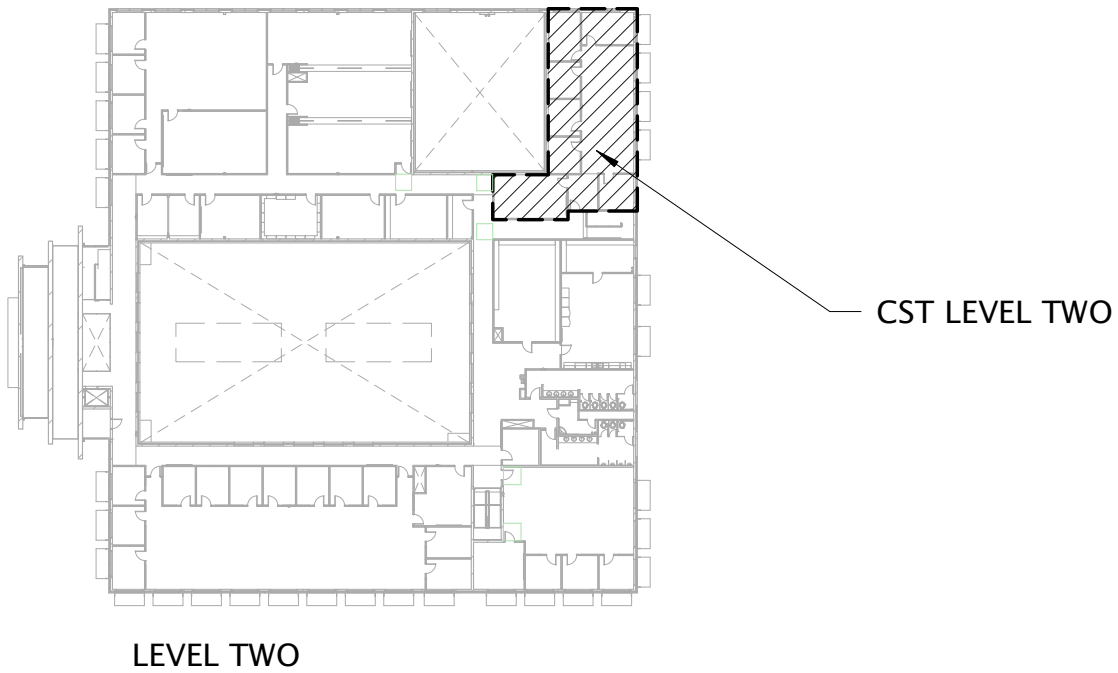
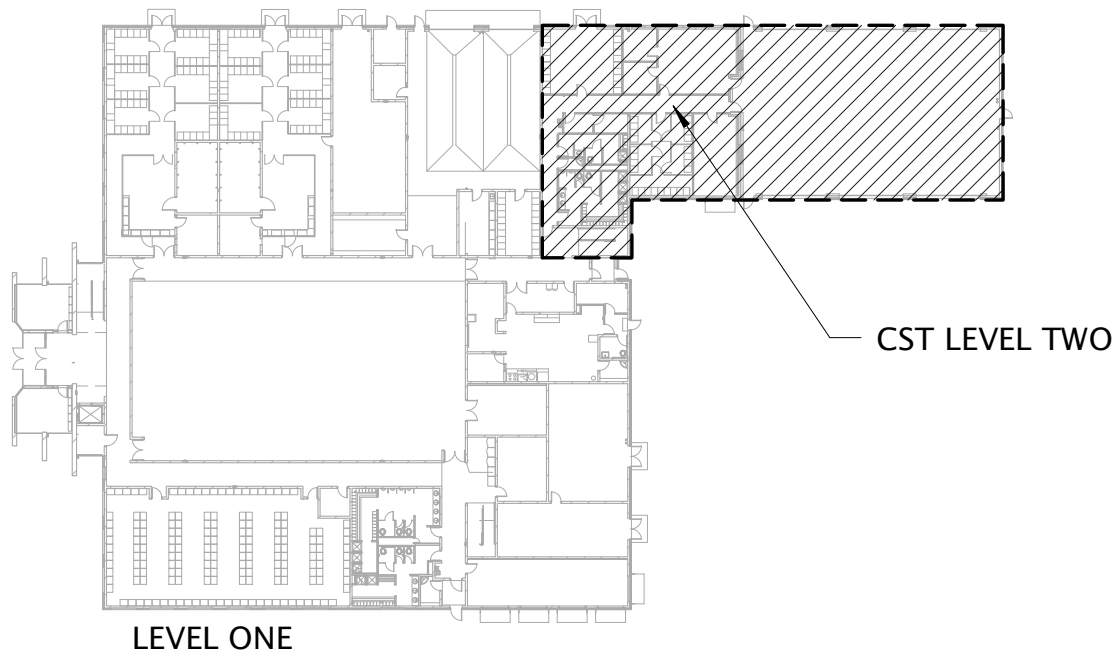
Type of Organization: _____
(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

Respectfully submitted,

Name of Proposer
ADDRESS:

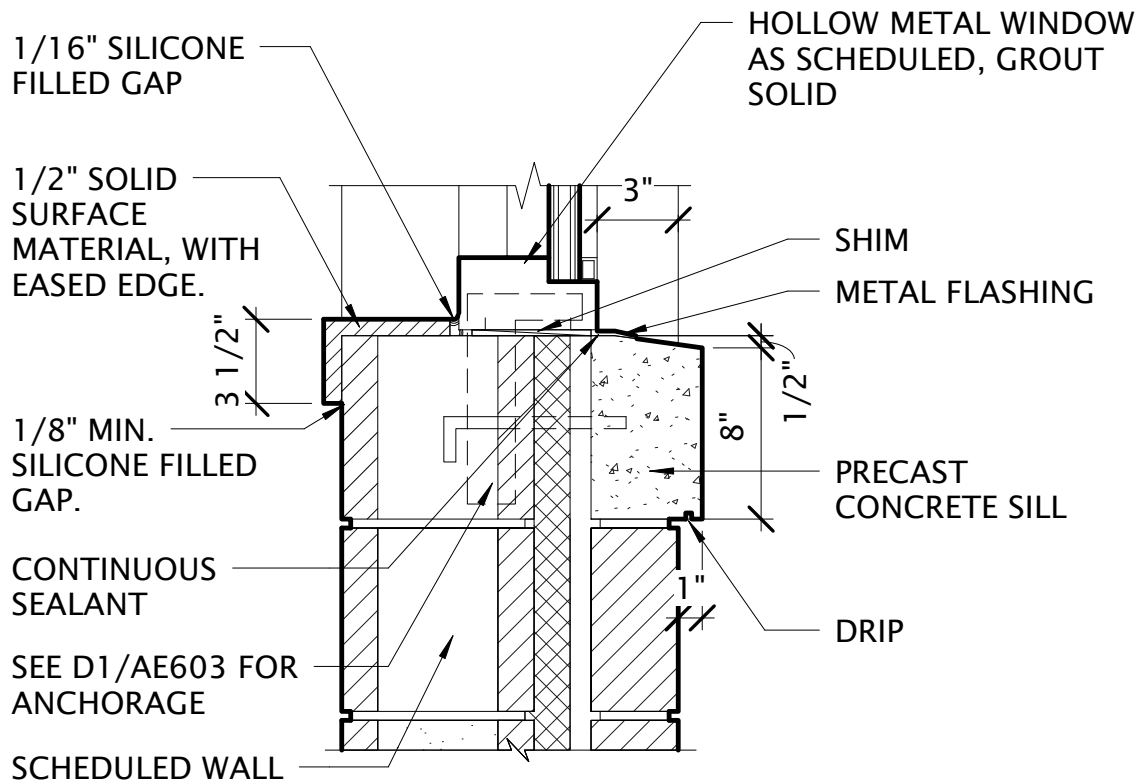
Authorized Signature



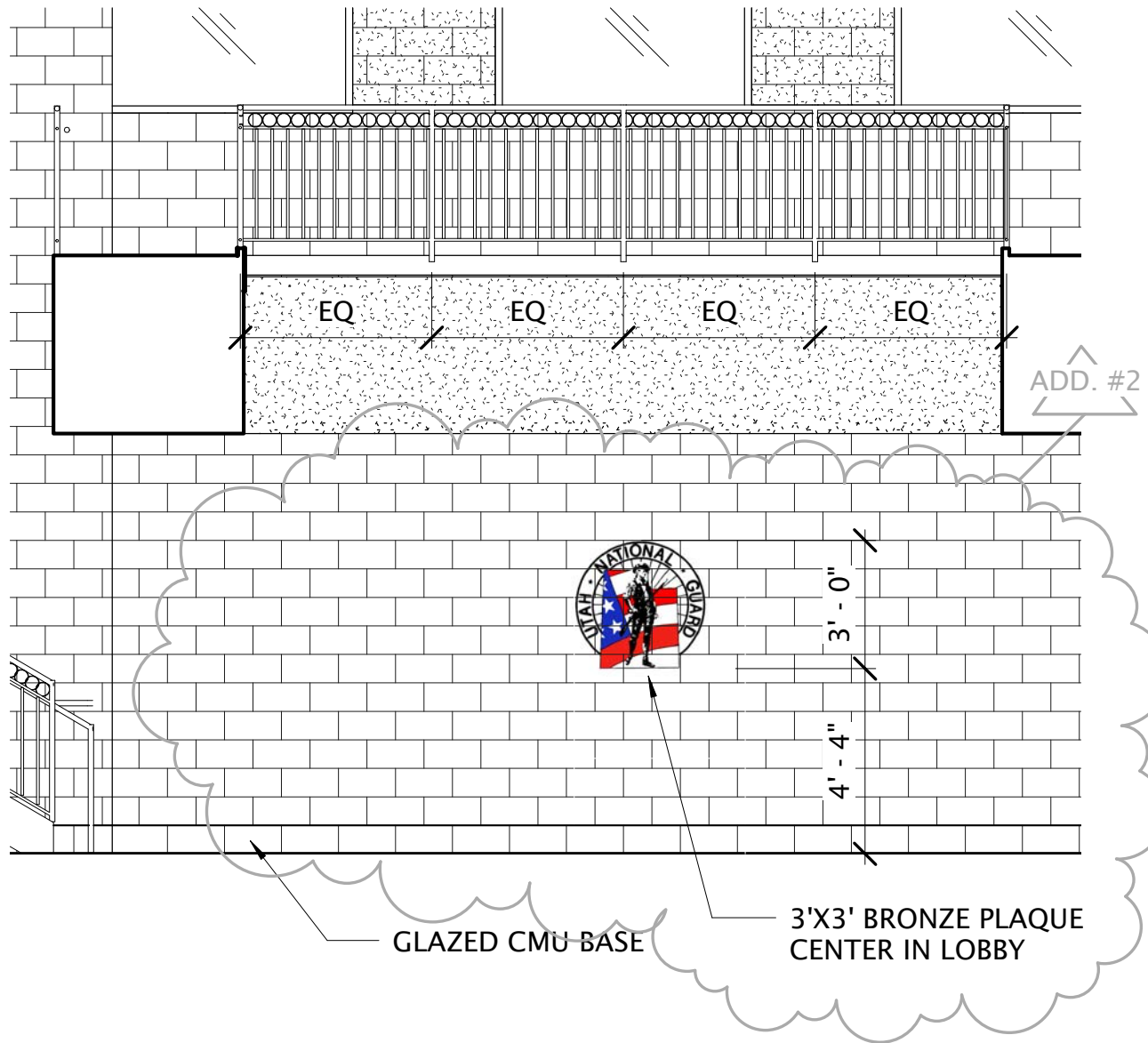
EXTERIOR FINISH LEGEND

ITEM	BASIS OF DESIGN	COLOR	COMMENTS
WALLS:			
BRICK VENEER, ATLAS BRICK		SEE SPECIFICATION	
PRE-MAN. METAL BUILDINGS		SEE SPECIFICATION	
ENTRY CANOPY:			
COMPOSITE METAL PANEL SYSTEM		SEE SPECIFICATION	COLOR AND FINISH TO MATCH ALUMINUM STORE FRONT: CLEAR ANODIC, MEDIUM MATT
ROOFTOP LIGHT MONITORS:			
METAL PANELS, SOFFIT AND TRIM	MBCI	KOKO BROWN	
PRECAST CONCRETE:			
WINDOW HEADS AND SILLS	MODERN	SAN DIEGO BUFF	
WALL CAP BETWEEN GRIDS 1 @ 2	PRECAST	CORAL REEF	COLOR AND FINISH TO MATCH ATLAS BRICK
EXTERIOR STEEL:			
HOLLOW METAL DOORS, WINDOWS AND MISC. STEEL			COLOR AND FINISH TO MATCH ALUMINUM STORE FRONT: CLEAR ANODIC, MEDIUM MATT
SUN SHADE SYSTEM:			
ALL COMPONENTS OF SUN SHADE			COLOR AND FINISH TO MATCH ALUMINUM STORE FRONT: CLEAR ANODIC, MEDIUM MATT
MISC TRIM:			
CAP FLASHING @ TOP OF WALLS AND MISC. METAL FLASHING.	MBCI	KOKO BROWN	

NOTE: NAMES INDICATED FOR COLOR, TEXTURE, OR PATTERN SELECTION ONLY. OTHER MANUFACTURERS MATERIALS ARE ACCEPTABLE PROVIDED THEY CLOSELY APPROXIMATE COLOR, TEXTURE AND PATTERN INDICATED AND PROVIDED THEY CONFORM TO ALL OTHER REQUIREMENTS.

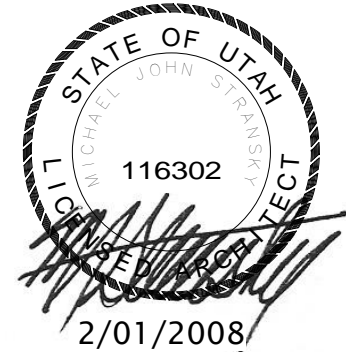
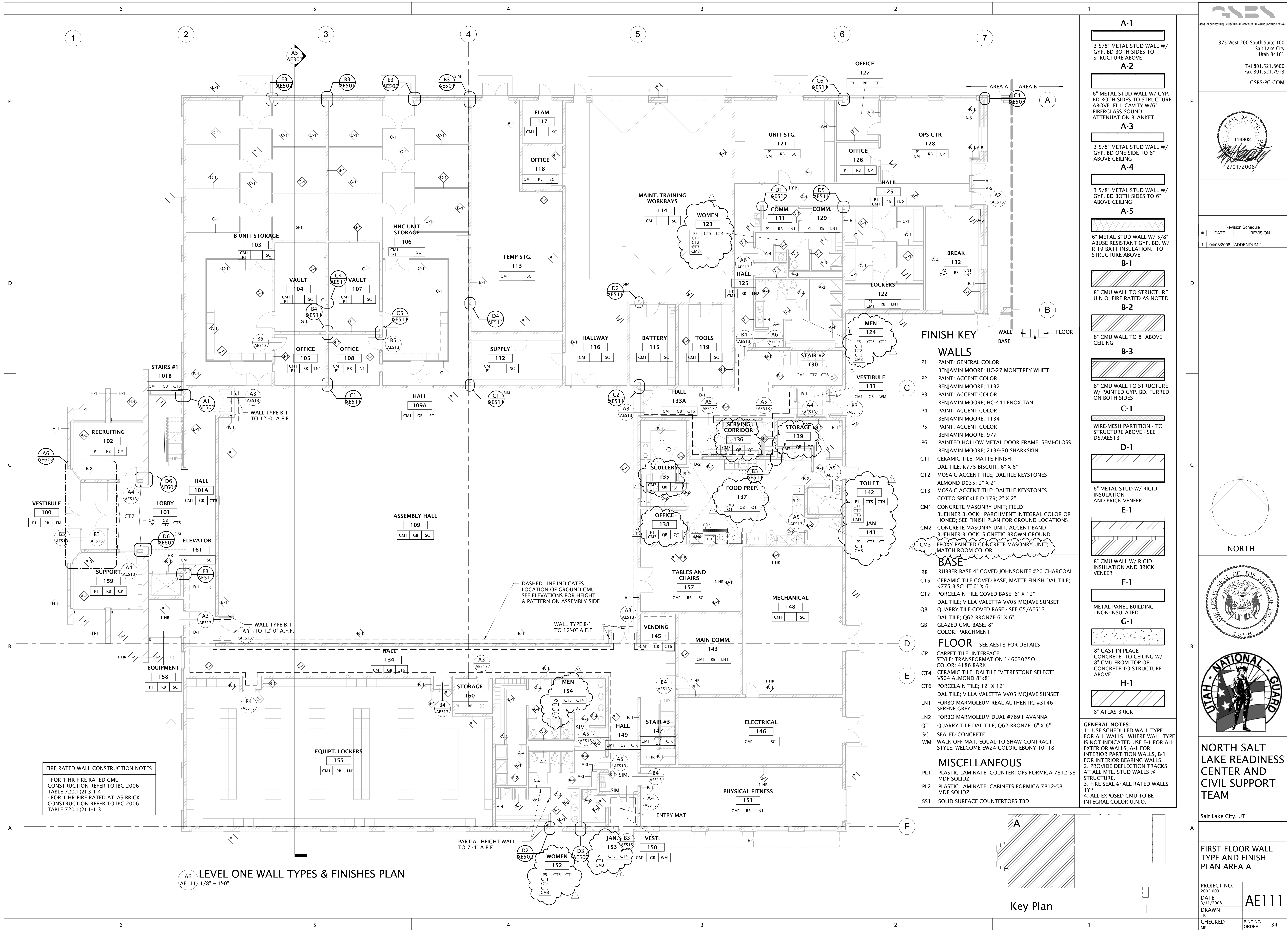


WINDOW SILL DETAIL A1/AE603

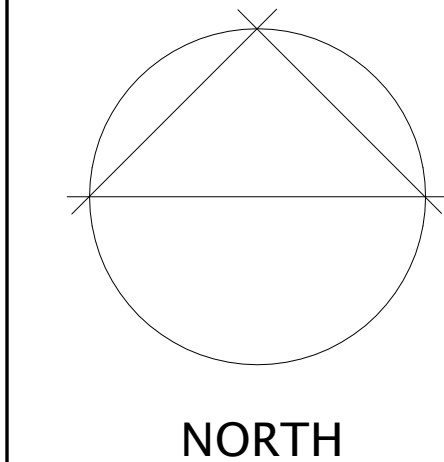


DETAIL-D6/AE212





Revision Schedule	
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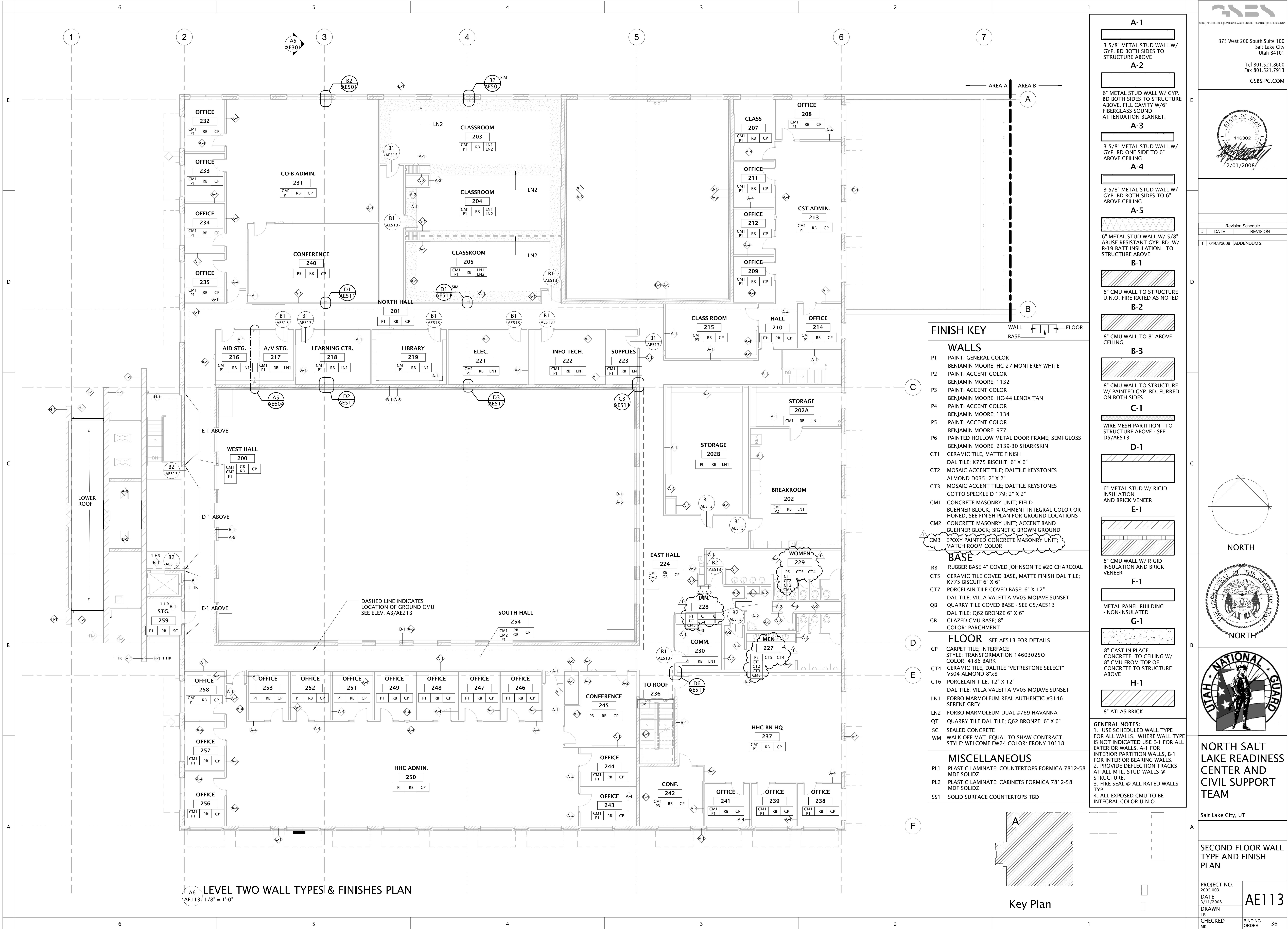



NORTH SALT
LAKE READINESS
CENTER AND
CIVIL SUPPORT
TEAM

Salt Lake City, UT

FIRST FLOOR WALL
TYPE AND FINISH
PLAN-AREA A

PROJECT NO. 2005-003	AE111
DATE 3/11/2008	
DRAWN TK	
CHECKED MK	
BINDING ORDER	34

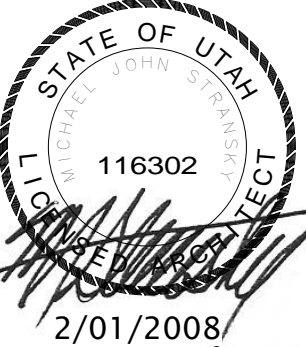




GSBS | ARCHITECTURE | LANDSCAPE ARCHITECTURE | PLANNING | INTERIOR DESIGN

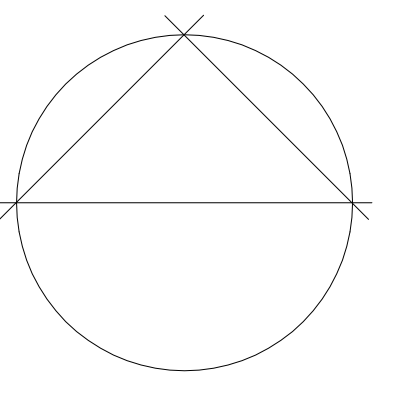
375 West 200 South Suite 100
Salt Lake City
Utah 84101

Tel 801.521.8600
Fax 801.521.7913
GSBS-PC.COM




116302
2/01/2008


Revision Schedule	
#	DATE
1	04/03/2008 ADDENDUM 2



NORTH



NORTH



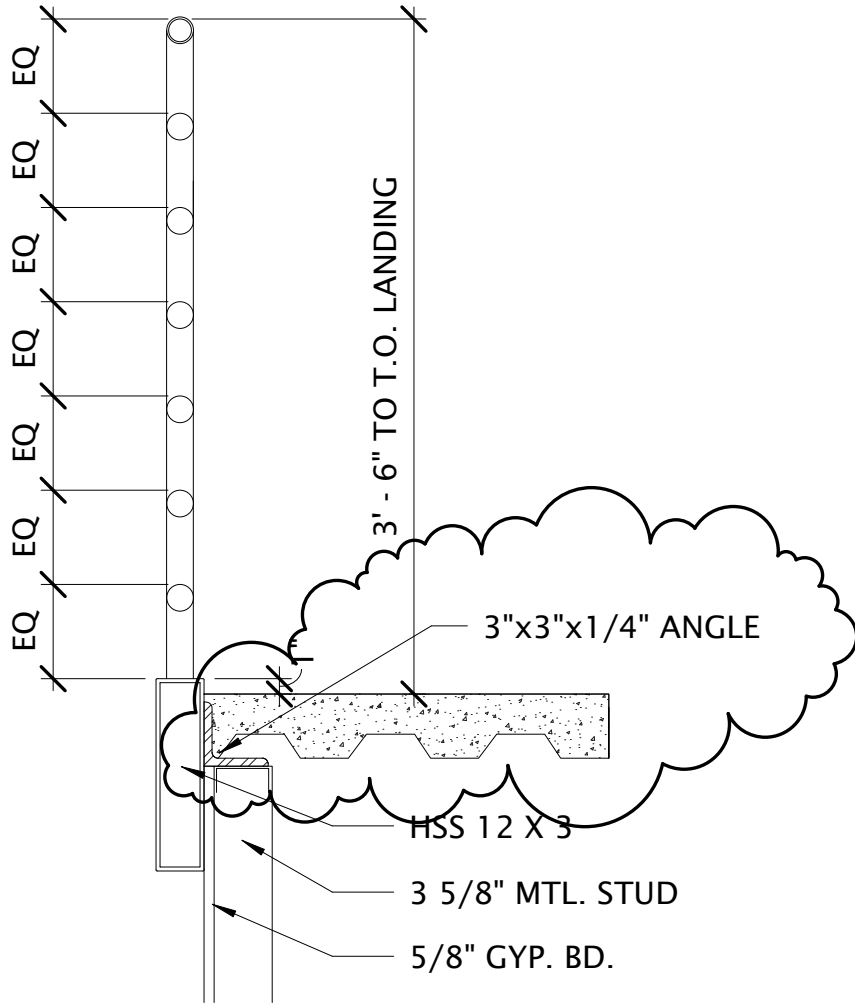
UTAH NATIONAL GUARD

NORTH SALT LAKE READINESS CENTER AND CIVIL SUPPORT TEAM

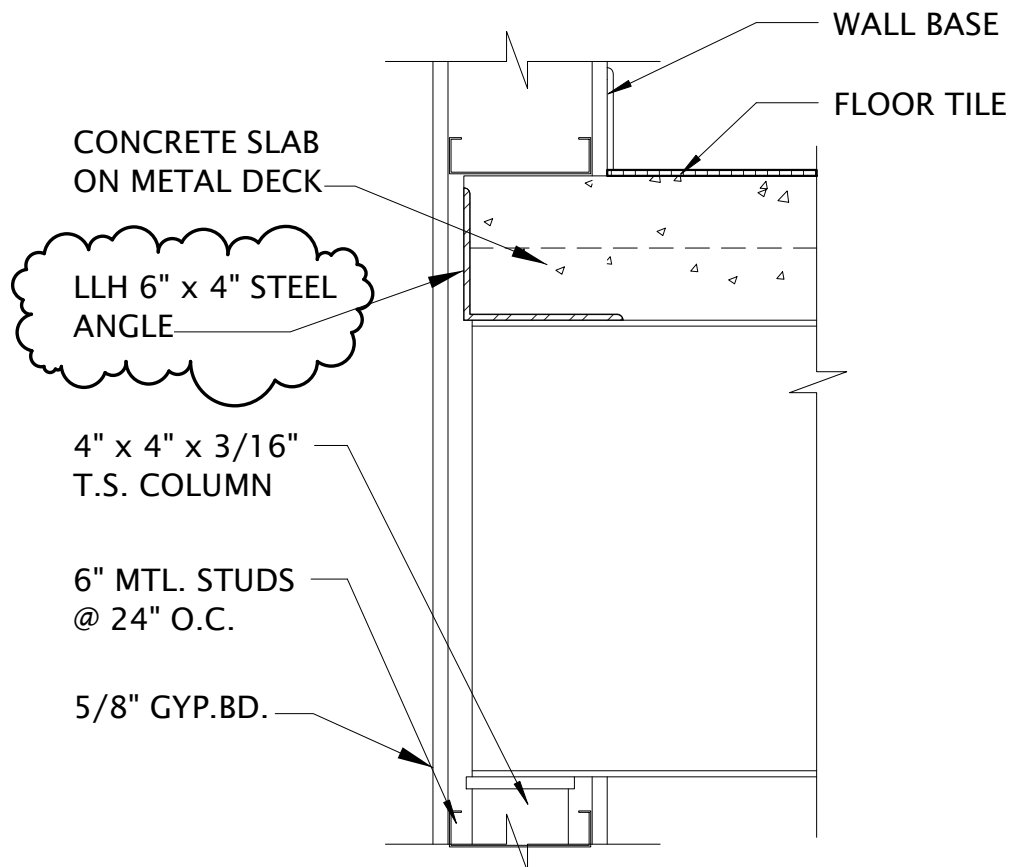
Salt Lake City, UT

SECOND FLOOR WALL TYPE AND FINISH PLAN

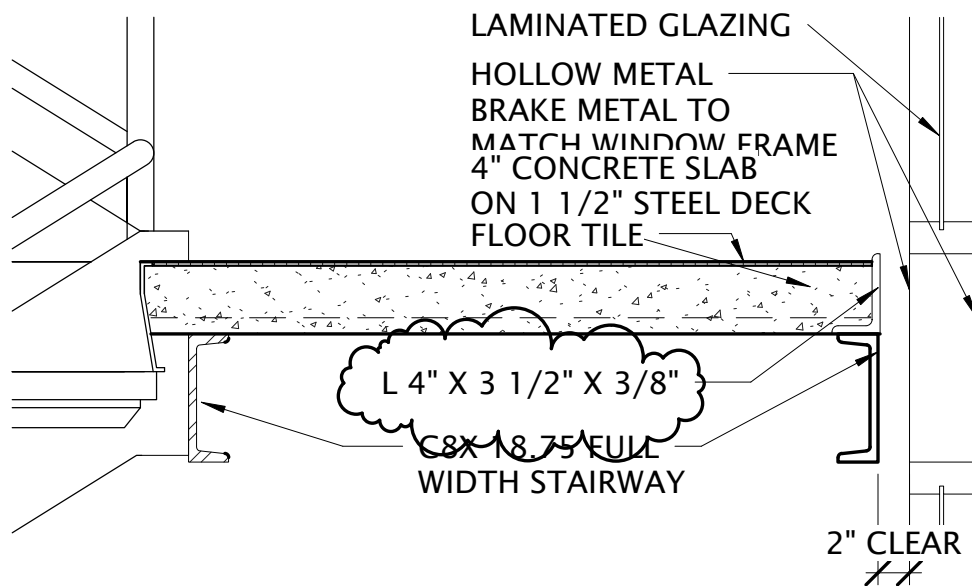
PROJECT NO. 2005.003	AE113
DATE 3/11/2008	
DRAWN TK	
CHECKED MK	
BINDING ORDER	36



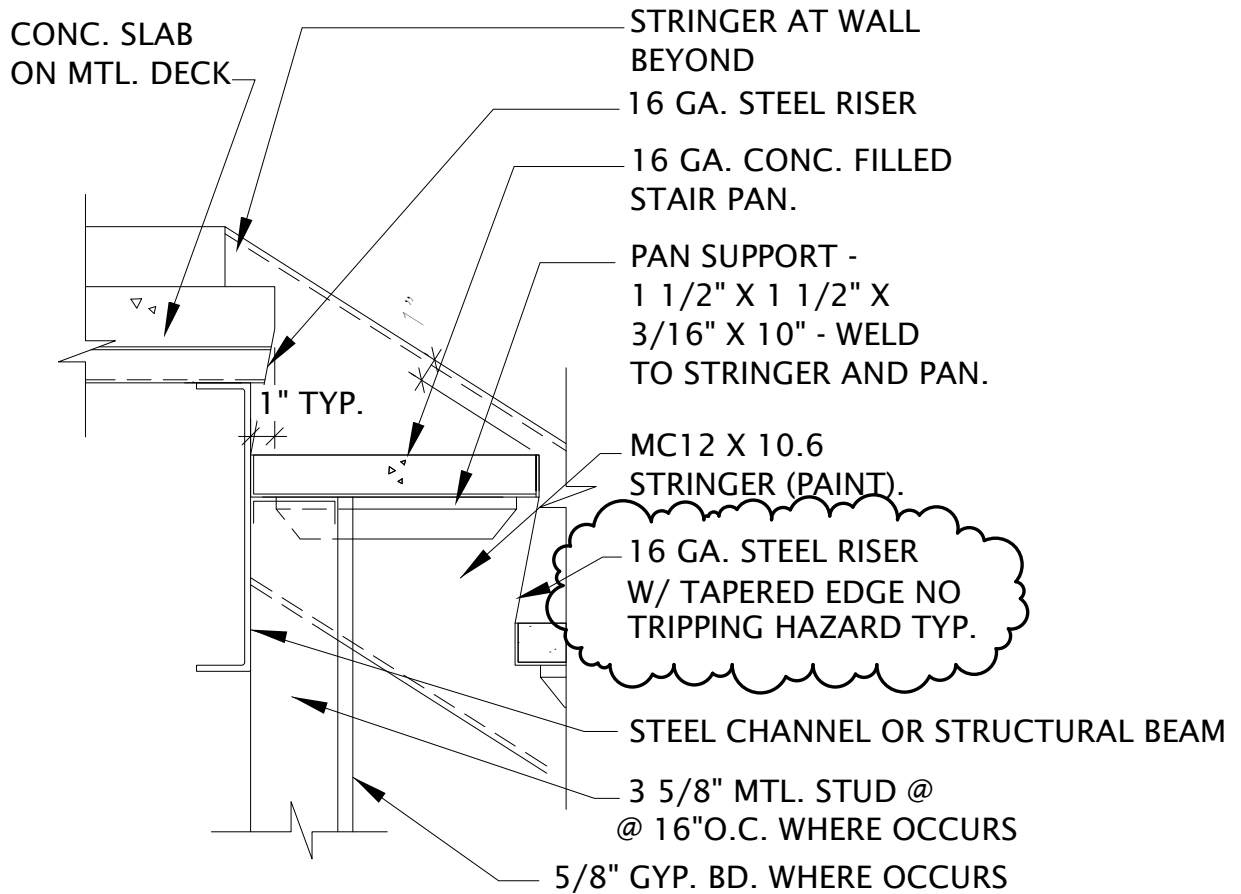
DETAIL D6/AAE412



DETAIL D6/AE411



DETAIL E3/AE411



DETAIL C6/AE41 1

1.66" O.D. (1 1/4" STD.) STL. PIPE PTD. RAILS & GUARDS

4" MAX. CLEAR

CONCRETE ON METAL DECKING

C8 x 18.75 STAIR CHANNEL

12 GA. CONCRETE FILLED STAIR PAN

PAN SUPPORT 1 1/2" x 1 1/2" x 3/16 x 10" WELD TO STRINGER AND PAN

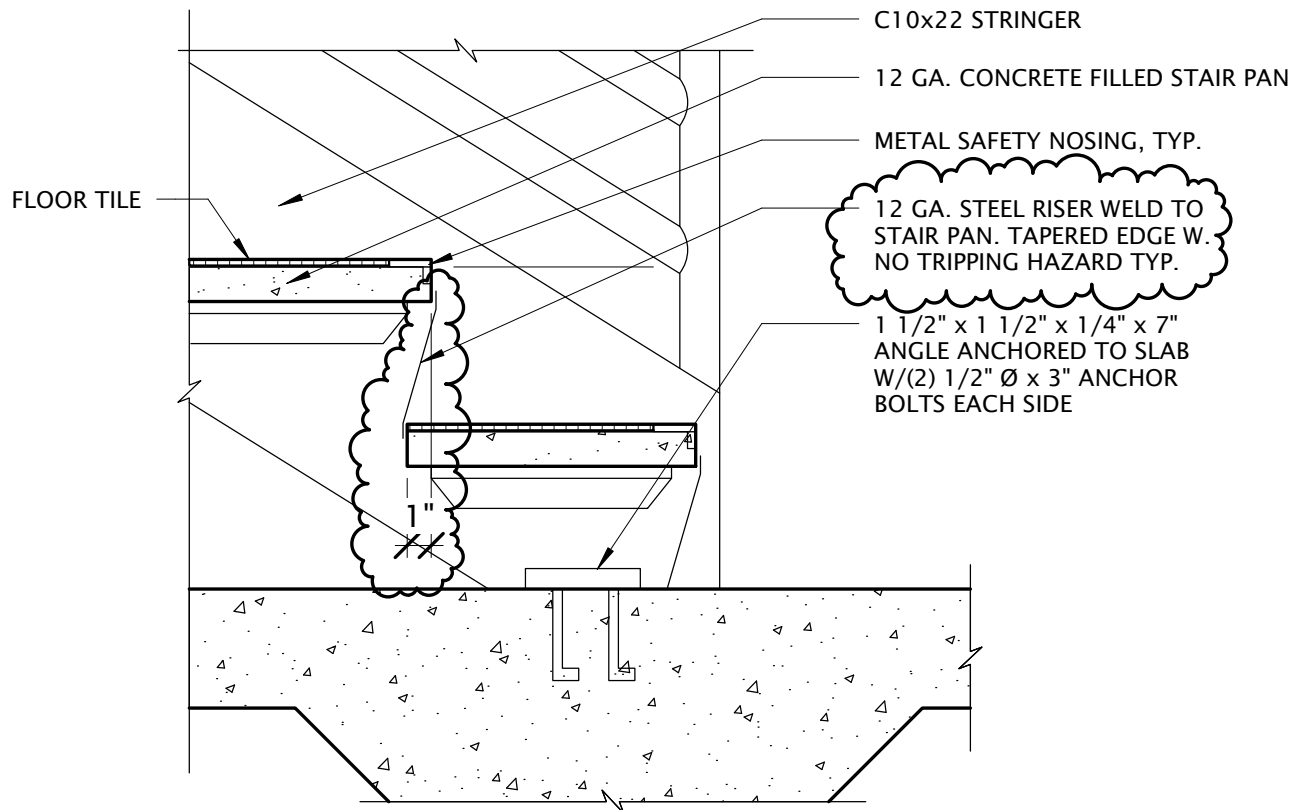
METAL SAFETY NOSING TYP.

12 GA. STEEL RISER WELD TO STAIR PAN. TAPERED EDGE WITH NO TRIPPING HAZARD TYP.

FLOOR TILE

C12 x 20.7 STRINGER

DETAIL B6/AE41 1



DETAIL A6/AE411

SECTION 033300 - ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-In-Place Concrete" for formwork; material, fabrication, and installation requirements for steel reinforcement; and field quality control.
 - 2. Division 07 Section "Joint Sealants" for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.

1.3 DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.
- D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

- a. Include statement indicating costs for each product having recycled content.
- 2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements and for equivalent concrete mixtures that do not contain portland cement replacements.
- C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.
- E. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- F. Samples: For each of the following materials:
 - 1. Form-facing panel.
 - 2. Form ties.
 - 3. Form liners.
 - 4. Coarse- and fine-aggregate gradations.
 - 5. Chamfers and rustications.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. Source Limitations for Cast-in-Place Architectural Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from one manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
 - 2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."
- D. Field Sample Panels: Before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under sample submittals. Produce a minimum of 3 sets of full-scale panels, cast vertically, approximately **48 by 48 by 6 inches (1200 by 1200 by 150 mm)** minimum, to demonstrate the expected range of finish, color, and texture variations.

1. Locate panels as directed by Architect.
2. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.
3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. OR Demolish and remove field sample panels when directed.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for formwork and other form-facing material requirements.
- B. Form-Facing Panels for As-Cast Finishes: Steel, glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- D. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.
- E. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, **3/4 by 3/4 inch (19 by 19 mm)**, minimum; nonstaining; in longest practicable lengths.
- F. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum **1/4 inch (6 mm)** thick.
- G. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, that adheres to form joint substrates.
- H. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.
- I. Form-Release Agent: Commercially formulated colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

- J. Form Ties: Factory-fabricated, glass-fiber-reinforced plastic, internally disconnecting or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish ties with tapered tie cone spreaders that, when removed, will leave holes **1 inch (25 mm)** in diameter on concrete surface.
 - 2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT AND ACCESSORIES

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

2.3 CONCRETE MATERIALS

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

2.4 ADMIXTURES

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

2.5 CURING MATERIALS

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

2.6 REPAIR MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES, GENERAL

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

2.8 CONCRETE MIXING

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

PART 3 - EXECUTION

3.1 FORMWORK

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for formwork, embedded items, and shoring and reshoring.
- B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.
- C. Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.
 - 1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
 - 2. Do not use rust-stained steel form-facing material.
- E. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- F. Chamfer exterior corners and edges of cast-in-place architectural concrete.
- G. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 REINFORCEMENT AND INSERTS

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.
- B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than **50 deg F (10 deg C)** for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Schedule form removal to maintain surface appearance that matches approved field sample panels.
- B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

- A. Construction Joints: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
 - 2. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
- B. Contraction Joints: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- C. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least **6 inches (150 mm)** into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.
- D. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below **40 deg F (4.4 deg C)** for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
 - 4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.
- E. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below **90 deg F (32 deg C)** at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.6 FINISHES, GENERAL

- A. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.

1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
- C. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.

3.7 AS-CAST FORMED FINISHES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects.

3.8 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.
- B. Begin curing cast-in-place architectural concrete immediately after removing forms from concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural concrete continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.
 3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 FIELD QUALITY CONTROL

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for field quality-control requirements.

3.10 REPAIRS, PROTECTION, AND CLEANING

- A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
 - 1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.
- B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
- D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- E. Wash and rinse surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.
 - 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION 033300

SECTION 311000 - SITE PREPARATION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Preparation
- B. Clearing and grubbing
- C. Topsoil removal
- D. Asphaltic concrete pavement removal
- E. Portland cement concrete removal
- F. Removal of fences and miscellaneous obstructions
- G. Disposal of waste materials

1.02 QUALITY ASSURANCE

- A. All tree trimming and removal shall be done in accordance with recognized tree surgery standards.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 PREPARATION

- A. No clearing, demolition, or removal of any kind shall proceed until all existing trees, improvements, etc. to be removed have been established and are inspected and documented by the Owner.
- B. Establish necessary clearing limits within the construction limits. Mark all trees, shrubs, structures, fences, concrete, and other improvements to be removed.
- C. Within 10 feet of clearing limits, inspect, photograph with video tape, and record condition of concrete slabs, structures, landscaping and other features to remain which might be affected by work. Allow Owner to view tape and approve prior to proceeding with the work.

- D. Trees, shrubs and lawn, areas to receive planting, rock outcroppings, fences, sprinklers and other improvements that are not to be removed shall be protected from damage or injury. If damaged or removed, they shall be restored or replaced in as nearly the original condition and location as is reasonably possible. Trees, shrubs, and improvements not to be removed shall be marked in field by Owner and/or shown on the Drawings.
- E. Give reasonable notice to Owner to permit him to salvage plants, trees, fences, sprinklers and other improvements within the construction limits that may be destroyed because of the work.
- F. Notify interested utility companies to be present if disturbing ground in the vicinity of utilities.
- G. Protect active utility systems adjacent to or uncovered by any excavation during site preparation.
- H. Maintain benchmarks, monuments and other reference points and construction stakes.
- I. Protect all improvements to remain or outside of construction from tree removal and/or pruning work.

3.02 CLEARING AND GRUBBING

- A. Remove all surface vegetation to a depth necessary for complete removal of all roots and other deleterious materials from within the areas to receive structural fill or base course.
- B. All trees, stumps, roots, etc. to be removed within the construction limits shall be cut off, excavated, or removed to a depth of not less than 3 feet below the existing ground.
- C. Branches of trees extending over the construction limits shall be trimmed to the boles to give a clear height of 20 feet above the existing ground surface. All trimming shall be done in accordance with recognized tree surgery standards. Remove additional tree branches under the direction of the Owner in such a manner that the tree will present a balanced appearance.

3.03 TOPSOIL REMOVAL

- A. Before any construction activity begins, remove topsoil to a maximum depth of 1', unless otherwise required by individual property owner, and stockpile on the same property of which topsoil was removed. Stockpile where required by individual property owner.
- B. Topsoil shall be protected from contamination by weeds, debris, etc. and shall be replaced, graded and lightly compacted by Contractor at completion of project.

3.04 ASPHALTIC CONCRETE PAVEMENT REMOVAL

- A. Sawing shall be used to ensure the breakage of pavement along straight lines.

3.05 PORTLAND CEMENT CONCRETE REMOVAL

- A. Concrete shall be removed to neatly sawed edges with saw cuts made to a minimum depth of 4 inches.
- B. Concrete sidewalk or driveway to be removed shall be neatly sawed in straight lines either parallel to the curb or at right angles to the alignment of the sidewalk. No section to be replaced shall be smaller than 30 inches in either length or width.
- C. Unless otherwise shown on the Drawings, if the sawcut would fall within 30 inches of a construction joint, expansion joint, or edge, the concrete shall be removed to the joint or edge, except that where the saw cut would fall within 12 inches of a score mark, the saw cut shall be made in and along the score mark.
- D. Curb and gutter to be removed shall be sawed to a depth of 1-1/2 inches on a neat line at right angles to the curb face.

3.06 FENCES AND MISCELLANEOUS OBSTRUCTIONS

- A. No demolition or removal of fences or miscellaneous obstructions shall proceed until clearance is obtained from the Owner.

3.07 DISPOSAL OF WASTE MATERIALS

- A. Where salvage is not required as otherwise specified herein or as shown on the drawings, dispose of all removed materials at a suitable off-site location in accordance with applicable laws and ordinances.
- B. No burning shall be allowed.

END OF SECTION

SECTION 312200 - GRADING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Preparation
- B. Excavation and filling
- C. Disposal of excess excavated and waste materials
- D. Compaction
- E. Dust and surface water control
- F. Field quality control
- G. Protection

1.02 RELATED WORK

- A. Section 312300 - Excavating, Backfilling, and Compaction

1.03 QUALITY ASSURANCE

- A. Comply with federal, state, and local codes and regulations.
- B. All working conditions shall be in accordance with the "Utah Occupational Safety and Health Standard for Construction".
- C. Freezing weather:
 - 1. Unless scheduling requirements of these specifications dictate otherwise, construction of fills during freezing weather shall not be done without approval of the Owner.
 - 2. If placement of earth materials during freezing weather is permitted by the Owner, such permission does not relieve the Contractor of the responsibility to perform the work in accordance with these specifications and at no additional cost to the Owner.

1.05 SUBMITTALS

- A. Submit the following in accordance with Section 013300 – SUBMITTAL PROCEDURES:
 - 1. 50 lb. sample of structural fill material to be used. Submit samples packed tightly in containers to prevent contamination.

PART 2 PRODUCTS

GRADING

312200 - 1

2.01 FILL MATERIALS

A. Structural Fill:

1. Shall not be lumpy or frozen.
2. Shall be free from large concentrations of alkali, salt, and petroleum products, all roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Owner is objectionable or deleterious.
3. Shall be "clean" granular soils graded within the following limits.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
4 inch	100
No. 200	5 min.-20 max.

LL of fines less than 35

PI of fines less than 15

4. A maximum particle size of 2 inches is required of structural fill placed in confined areas.
5. Moisture conditions at the time of placement shall be such the material used will be compactable to required specs.
6. Shall be approved by the Engineer prior to being used on the site of the work.

B. Stabilizing structural fill: Mixture of clean coarse gravels and cobbles.

C. Non-structural fill:

1. Shall not be lumpy or frozen.
2. Shall be free from large concentrations of alkali, salt, and petroleum products, all roots, sod, limbs, and other vegetative matter, rocks larger than 6 inches in diameter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Owner is objectionable or deleterious.
3. Shall be either cohesive or granular.

PART 3 EXECUTION

3.01 PREPARATION

- A. Within 10 feet of construction limits, inspect, photograph, and record condition of concrete slabs, structures, landscaping and other features to remain which might be affected by clearing. Mark with paint any existing cracks on concrete along which work will take place, in order to determine after the construction is completed whether such damage was caused by the operations of the Contractor or had occurred previously. Any concrete showing unmarked cracks upon completion of construction will be evidence of damage by the Contractor's forces, and shall be replaced or repaired to the satisfaction of the Owner of the damaged concrete, at the Contractor's own expense.

- B. Obtain necessary permits required for grading.
- C. Trees, shrubs and lawn, areas to receive planting, rock outcroppings, fences, and other improvements that are not to be removed shall be protected from damage or injury. If damaged or removed, they shall be restored or replaced in as nearly the original condition and location as is reasonably possible.
- D. Establish the location and extent of all underground utilities. Notify necessary utility companies to be present if disturbing ground in the vicinity of utilities. Protect active utility systems adjacent to or uncovered by any excavation during site grading. Maintain, re-route or extend as required, existing ditches, pipelines or utility lines to remain which pass through the construction limits. Pay costs for this work, except those covered by the utility companies. Accurately locate and record abandoned and active utility lines re-routed or extended, on Project Record Documents. Call Blue-Stakes for utility location.
- E. Maintain benchmarks, monuments and other reference points.
- F. Appropriate traffic control devices shall be provided in accordance with federal, state or local regulations to regulate, warn, and guide traffic at the work site.
- G. All work shall be performed so as to insure the least possible interference with the public convenience.

3.02 EXCAVATION AND FILLING

- A. Excavate cut areas to proper elevation. When Structural Fill or other material is to be placed upon exposed surface, take care to prevent disturbing of soils. A smooth-lipped bucket, or other equipment which will produce a smooth, undisturbed surface, shall be used to excavate areas which require placement of Structural Fill or other material on undisturbed natural soil subgrade. Excavation equipment with "teeth" shall not be used as this equipment may disturb the subgrade soils.
- B. Placement of Structural Fill:
 - 1. Structural Fill shall be used to fill below an area which is to be structurally loaded, or which is to support slab-on-grade or pavement, and shall extend from undisturbed native soil to the proper subgrade elevation. Excavated material which meets the specification requirements, including compaction and moisture provisions, may be used as Structural Fill.
 - 2. Under areas to receive structural fill, topsoil shall be completely removed.
 - 3. Prior to placing the structural fill, the subgrade shall be proof-rolled by passing moderately-loaded rubber tire-mounted construction equipment uniformly over the surface continuously at least twice. If excessively soft, loose or disturbed soils are encountered, they shall be removed as directed by Owner, to a maximum depth of two feet, and replaced with STABILIZING STRUCTURAL FILL, compacted to 90% of the maximum laboratory dry density determined by ASTM D-1557 or AASHTO T-180.
 - 4. Prior to placing structural fill, the area to receive the fill shall be prepared as specified in Section 311000.

5. Structural fill should be placed in lifts not exceeding 8 inches in loose thickness.
- C. Placement of Non-Structural Fill:
 1. Non-Structural Fill shall be used to fill all areas which do not require Structural Fill. Excavated material which meets the specified gradation, compaction and moisture requirements may be used as Non-Structural Fill.
 2. Prior to placing Non-Structural Fill, the area to receive the fill shall be cleared as specified above.
 3. Non-Structural fill should be placed in lifts not exceeding 12 inches in loose thickness.
- D. Grading Tolerances:
 1. Finish areas to within not more than 0.10' above or below required elevations.
- F. Uniformly grade areas within construction limits, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.
- G. Unauthorized excavation:
 1. Unauthorized excavation consists of removal of materials beyond indicated elevations or dimensions without specific direction of the Owner.
 2. Correct unauthorized excavation as directed, at no cost to the Owner.
- H. All material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.
- I. Fills adjacent to structures shall be placed around the structure in lifts of constant elevation until finish grade is achieved.

3.03 DISPOSAL OF EXCESS EXCAVATED AND WASTE MATERIALS

- A. Remove waste material, unacceptable excavated material, surface and sub-surface vegetation, trash and debris and dispose of it off Owner's property in accordance with all applicable laws and ordinances.
- B. Excess excavated material shall be disposed of at the site shown on the Drawings. When quantity shown has been exceeded, dispose of excess excavated material off Owner's property in accordance with all applicable laws and ordinances.

3.04 COMPACTION REQUIREMENTS

- A. Each layer of structural fill shall be compacted to at least 95% of the maximum dry density, as determined by the ASTM D-1557 (AASHTO T-180) method of compaction. Non-structural fill shall be compacted to at least 90% of the maximum dry density, as determined by the ASTM D-1557 (AASHTO T-180) method of compaction.

- B. Where layer of soil material to be compacted must be moisture conditioned before compaction, uniformly apply water to surface of layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operation.
- C. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.06 DUST AND SURFACE WATER CONTROL

- A. Dust control measures shall be implemented by application of water to all work areas, storage areas, haul and access roads, or other areas affected by work.
- B. All work shall be in compliance with the Federal, State, and local air pollution standards, and not cause a hazard or nuisance to personnel and the public in the vicinity of the work.
- C. Provide and operate at least 1 mobile tank sprinkling unit during the contract period.
- D. Other methods of dust control for haul and access roads may include chemical treatment, light bituminous treatment or other method as approved by the Owner.
- E. Surface water shall be controlled to the extent that the areas to receive pavement, walks or slabs are not allowed to become wet from runoff from adjacent areas. Surface water shall be directed away from these areas but not directed toward adjacent property, buildings, or any improvement that may be damaged by water. Surface water shall not be allowed to enter sanitary sewers.

3.07 FIELD QUALITY CONTROL

- A. Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.
- B. Testing of compacted fill materials and subgrades will be performed by testing agency employed by the Contractor. If, during progress of work, tests indicate that compacted materials do not meet specified requirements, remove defective work, replace and retest at no cost to Owner.
- C. In each compacted fill layer, testing service shall perform at least one field density test for every 2000 sq. ft. of fill area, but in no case less than 3 tests.

3.08 PROTECTION

- A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades in settled, eroded, and retted areas to specified tolerances.

- C. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.
- D. Where settling is measurable or observable in excavated or filled areas during general project warranty period, remove surface (pavement, lawn or other finish), add structural fill material, compact to required specifications, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION

SECTION 312300 - TRENCH EXCAVATING, BACKFILLING AND COMPACTION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Contractor shall provide all materials, labor, equipment, transportation and other items required to perform excavation, backfilling and compaction Work as indicated or as required to accomplish Work of other sections of these specifications. All excavation, backfilling and compaction Work shall be in accordance with applicable regulations and as specified herein.
- B. Excavating, backfilling and compaction includes, but is not limited to the following:
 - 1. Preparation
 - 2. Excavation, backfilling and compaction
 - 3. Dewatering and/or runoff control measures
 - 4. Trench shoring
 - 5. Clean up, protection, maintenance

1.02 RELATED WORK

- A. Section 333100 – Sanitary Sewage Systems
 - 1. Trench excavation, bedding, backfill and compaction requirements.
- B. Section 334100 - Storm Sewage Systems
 - 1. Trench excavation, bedding, backfill and compaction requirements.

1.03 REFERENCES

- A. The applicable provisions of the latest editions of the References listed below shall govern the Work covered under this Section, unless there is a conflict between said References and the requirements of this Section. In the case of such a conflict, the requirements of this Section shall apply.
- B. Utah Occupational Safety and Health Division (UOSHD).
- C. American Association of State Highway and Transportation Officials (AASHTO):
- D. American Society for Testing and Materials (ASTM)

1.04 SUBMITTALS

- A. Submit evidence of materials conformance with applicable requirements as well as these specifications.

1.05 QUALITY ASSURANCE

- A. Comply with federal, state, and local codes and regulations.
- B. All working conditions shall be in accordance with the "Utah Occupational Safety and Health Division", Safe Practices for Excavation & Trenching Operations, latest edition, or other Laws or Regulations which apply.

1.06 DELIVERY, STORAGE AND HANDLING

Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials suppliers shall provide, upon request, verification of a consistent record of meeting or exceeding materials or performance standards as specified herein.

2.02 FOUNDATION MATERIALS

- A. All foundation materials shall be free from alkali, salt, and petroleum products, roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Engineer may be objectionable or deleterious.
- B. Undisturbed soil foundation material:
 - 1. Shall be natural trench bottom soil unless unable to adequately support pipe or structures.
 - 2. Shall not be lumpy or frozen.
- C. Gravel:
 - 1. Shall be hard, durable, broken stone or slag.
 - 2. Shall be graded within the following limits:

<u>Sieve</u>	<u>% Passing</u>
1"	100
3/4"	85-100
1/2"	20-40
No. 4	10-20

2.03 BEDDING MATERIALS

A. Sand Bedding Material:

1. Shall be free from alkali, salt, and petroleum products, roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Engineer may be objectionable or deleterious.
2. Graded within the following limits:

<u>Sieve</u>	<u>% Passing</u>
3/4"	100
No. 4	80-100
No. 10	30-50
No. 40	10-30
No. 200	0-15

2.04 BACKFILL MATERIALS

A. Granular backfill:

1. Shall be readily compactable and shall be free from alkali, salt, and petroleum products, roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Engineer may be objectionable or deleterious.
2. Graded within the following limits:

<u>Sieve</u>	<u>% Passing</u>
3 inch	100
No. 10	50 max.
No. 40	30 max.
No. 200	15 max.

3. May be select material from excavation if it will meet all requirements of granular backfill, including compaction requirements as specified for type of surface improvement above trench.

B. Excavated Soil Backfill Material:

1. Shall be free from alkali, salt, and petroleum products, roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Engineer may be objectionable or deleterious.
2. Shall be select material from excavation, with no particle larger than 4 inches in diameter.

3. Use on-site materials only if specified compaction requirements can be met.

PART 3 EXECUTION

3.01 EXAMINATION

- A. It shall be the Contractor's sole responsibility to locate all (whether or not shown on the Drawings) existing water, sanitary sewer, storm drain, and gas lines, electrical and telephone conduit and other underground utilities with their existing house service connections, and all other underground structures in order that no damage or loss of service will result from interference with existing lines.
- B. Review all available drawings, notes, and information on the location of these underground lines and structures in determining the location of the existing facilities.
- C. Have an electronic pipe finder on the job at all times and mark all lines on the road ahead of the excavating machine.
- D. Blue Stakes Location Center shall be contacted 48 hours before any excavation is commenced.
- E. Mark with paint any existing cracks on concrete along which work will take place, in order to determine after the construction is completed whether such damage was caused by the operations of the Contractor or had occurred previously. Any concrete showing unmarked cracks upon completion of construction will be evidence of damage by the Contractor's forces, and shall be replaced or repaired to the satisfaction of the Owner of the damaged concrete, at the Contractor's own expense.
- F. All fences removed for excavation shall be returned to their original condition except that damaged portions will be replaced with new fencing at the Contractor's expense.
- G. Obtain all required permits.

3.02 METHODS AND PROCEDURES

- A. General Requirements
 1. All gas, sanitary sewer, storm drain, water and other pipelines, flumes and ditches of metal, wood or concrete, underground electrical conduits and telephone cable, and all walks, curbs, and other improvements encountered in excavating trenches carefully shall be supported, maintained and protected from injury or interruption of service until backfill is complete and settlement has taken place.
 2. If any existing facility is damaged or interrupted, promptly after becoming aware thereof and before performing any Work affected thereby except in an emergency, identify the owner of such existing facility, and give written notice thereof to that

owner and the Owner and Engineer. Indemnify the Owner from any and all damages resulting from damaged facilities.

3. All damage, injury or loss resulting from lack of adequate sheeting, bracing, and shoring shall be the responsibility of the Contractor; and the Contractor shall effect all necessary repairs or reconstruction resulting from such damage.
4. The trenches shall not be backfilled until the utilities systems as installed conform to the requirements of the Drawings and Specifications. Where, in the opinion of the Engineer, damage is likely to result from withdrawing sheeting, the sheeting shall be left in place.
5. Trenches shall be backfilled to the proper surface with material as shown or specified. Trenches improperly backfilled shall be reopened to the depth required for correction, then refilled and compacted as specified, or the condition shall be otherwise corrected as approved.
6. Care shall be exercised so that when backfilling is complete and settlement has taken place, all existing pipes, flumes, ditches, conduits, cables, walks, curbs, and other improvements will be on the same alignment and grade as they were before work commenced.
7. Compaction shall be the responsibility of the Contractor. He shall select the methods to be used and carefully perform the work of backfilling and compaction so as to prevent damage to new or existing piping. Any new or existing piping damaged during the Contractor's work shall be replaced as directed by the Engineer with new piping.

3.03 INSTALLATION

A. Excavation

1. Excavation for pipe lines, concrete valve boxes, manholes and appurtenant structures shall include the work of removing all earth, sand, gravel, quicksand, stone, loose rock, solid rock, clay, shale, cement, hardpan, boulders, and all other materials necessary to be moved in excavating the trench for the pipe; maintaining the excavation by shoring, bracing, and sheeting or well pointing to prevent the sides of the trench from caving in while pipe laying is in progress; and removing sheeting from the trench after pipe has been laid.
2. Trench support system shall be suitable for the soil structure, depth of cut, water content of soil, weather conditions, superimposed loads, vibration. Contractor may select one of the following methods of ensuring the safety of workers in the trench, as approved by the Utah State Industrial Commission or its safety inspectors:
 - a. Sloping sides of trench to the angle of repose at which the soil will remain safely at rest.

- b. Shoring trench sides by placing sheeting, timber shores, trench jacks, bracing, piles, or other materials to resist pressures surrounding the excavation.
 - c. Using a movable trench box built-up of steel plates and a heavy steel frame of sufficient strength to resist the pressures surrounding the excavation.
- 3. Trenches shall be of the necessary width for proper laying of pipe. Care shall be taken not to overexcavate. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe along the entire length of the barrel of the pipe.
- 4. Trenches shall be excavated to the depths shown on the Drawings, including any required allowances for the sewer rock foundation, when required, and for other pipe bedding requirements.
- 5. Minimum cover over the top of the pipe, including any paving, shall be as follows:
 - a. Water supply piping: 3.5 feet minimum from finish grade.
- 6. Grading of trenches shall be performed to avoid interference of water and sewer lines with other underground utilities and structures:
 - a. Water supply piping: Unless otherwise indicated, trenches shall be graded to avoid high points with the necessity of placing vacuum and relief valves in the water lines.
- 7. The width of trench, measured at the top of the pipe, shall be as narrow as possible but not wider than 15 inches on each side of sewer or water pipe.
- 8. Excavation for manholes, concrete valve boxes, and similar structures shall be sufficient to leave at least 12 inches in the clear between the outer surfaces and the embankment or timber that may be used to hold and protect the banks.
- 9. Excess materials shall be hauled away from the construction site or otherwise disposed of by the Contractor as approved by the Engineer.

B. Backfilling

- 1. Materials for trench backfill shall be as shown on the Drawings.
- 2. Pipe bedding:
 - a. Consists of preparing an acceptable pipe foundation, excavating the pipe groove in the prepared foundation and backfilling from the foundation to 12 inches above the top of the pipe. All piping shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.

- b. Pipe foundation: Shall consist of natural soil in the bottom of the trench, or a built-up foundation if conditions so warrant. Wherever the trench subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, and where groundwater must be drained, the trench shall be excavated below the bottom of the pipe to such depth as may be necessary, and this additional excavation filled with clean, compacted sewer rock.
 - c. A pipe groove shall be excavated in the pipe foundation to receive the bottom quadrant of the pipe so that the installed pipe will be true to line and grade. Bell holes shall be dug after the trench bottom has been graded. Bell holes shall be excavated so that only the barrel of the pipe bears on the pipe foundation.
 - d. Pipe bedding from pipe foundation to 12 inches above top of pipe: Materials shall be deposited and compacted in layers not to exceed 8 inches in uncompacted depth. Deposition and compaction of bedding materials shall be done simultaneously and uniformly on both sides of the pipe. All bedding materials shall be placed in the trench with hand tools or other approved method in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses. Materials used shall be as shown in the Typical Trench Section in the Drawings and as specified in Part 2.
- 3. Each lift shall be evenly spread and moistened or dried by disk harrowing or other means so that the required density will be produced.
- 4. Backfill around valves with Granular Backfill Material.
- C. Compaction
 - 1. Backfill Compaction Requirements:
 - a. Under pavements, or other surface improvements, the minimum density shall be 95% of laboratory maximum density as determined by AASHTO Designation T-180 (ASTM D-1557).
 - b. In shoulders and other unimproved areas, the minimum density shall be 90% of laboratory maximum density as determined by AASHTO Designation T-180 (ASTM D-1557).
 - 2. Compaction shall be performed in strict accordance with the manufacturer's recommendations for each type of pipe.
 - 3. Mechanical compaction: Shall be accomplished by the use of sheeps-foot rollers, pneumatic tire rollers, vibrating rollers, or other mechanical tampers of a size and type necessary to achieve the required degree of compaction.

D. Dewatering

1. The Contractor shall do all pumping, shall build all drains and do all the work necessary to keep the trench and pipes free from water during the progress of the work.
2. In wet trenches, a channel shall be kept open along the side of the pipe for conducting the water to a sump hole, from which it shall be pumped out of the trench. No water shall be allowed to enter the pipe.

3.04 PROTECTION

- A. Provide barricades and restrict access as appropriate to prevent damage to Work in place.
- B. Contractor shall be responsible for protection of Work in place against displacement, damage, or loss until Owner's acceptance. Any work and subsequently damaged, lost or displaced shall be repaired or replaced to the Owner's satisfaction at no additional cost.

3.05 CLEANING

- A. Thoroughly clean, rake, wash, flush or sweep as required to clean adjacent improvements of materials covered as part of this Work prior to submitting for Owner's acceptance.
- B. Contractor shall provide all labor, equipment, materials and other items as required to perform clean up as required by the Owner, adjacent property owners and other jurisdictions.
- C. Finish grading of areas affected by this Work shall be required as part of clean up.
- D. The roadway including shoulders, slopes, ditches, and borrow pits shall be smoothly trimmed, and shaped by machinery, or other satisfactory methods, to the lines, grades and cross-sections, as established, and shall be so maintained until accepted. Any surplus material not suitable for spreading along the road to widen the existing shoulder or raise the grade shall be disposed of as specified above.

3.06 TESTING

- A. The Contractor shall employ a testing laboratory to perform field and laboratory density tests, except that the Contractor shall make such additional tests, at his expense, as deemed necessary by him to assure that the work of compaction is performed properly, determine any adjustments in compacting equipment, thickness of layers, moisture content and compactive effort or other means necessary to obtain the specified minimum relative density. Provide access to the work and all men and machinery necessary to aid the testing laboratory personnel in performing field density tests or taking samples for laboratory tests. In general, tests and samples shall be made as the work proceeds.
- B. Have testing laboratory perform maximum density tests on materials to be compacted from samples submitted by Contractor taken from locations selected by the Engineer.

- C. Have testing laboratory perform field density tests of compacted backfill materials. The approximate location and number of such tests shall be as shown on the drawings, as described in the Bid Form, or as selected by the Engineer. Field density tests shall be taken as follows:
1. In planted or unimproved areas:
 - a. 18" above the top of the pipe
 - b. Finished grade
 2. In streets, roads, parking lots or other paved areas:
 - a. 18" above the top of the pipe
 - b. 24" to 36" below the gravel road base
 - c. Gravel road base subgrade
 - d. Top of gravel road base
 - e. Top of bituminous surface course
- D. Copies of test results prepared by the testing laboratory shall be transmitted to the Contractor at the same time they are transmitted to the Engineer.
- E. Successful performance of compaction at the location of the field density test shall not relieve the Contractor of his responsibility to meet the specified density requirements for the complete project.

END OF SECTION

SECTION 321123 - BASE COURSE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Subgrade preparation to lines and grades shown on the plan.
- B. Place, grade and compact base and sub-base course materials.
- C. Dust and surface water control.

1.02 RELATED WORK

- A. Section 312300 - Excavating, Backfilling and Compaction
- B. Section 321200 - Asphaltic Concrete Paving

1.03 REFERENCES

- A. American Society for Testing Materials (ASTM).
- B. American Association of Safety and Highway Transportation Officials (AASHTO)

PART 2 PRODUCTS

2.01 BASE COURSE MATERIAL

- A. Road Base for Concrete Sidewalks, Concrete Curb and Gutter, and Waterways and Pavement Preparation shall be:
 - 1. Unwashed, hard, durable, angular pit run gravel or crushed natural stone.
 - 2. Shall be free from shale, silt, clay, loam, friable or soluble materials.
 - 3. Shall be free from noticeable concentrations of alkali, salt, and petroleum products, all roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that, in the opinion of the Engineer, is objectional or deleterious.

1" Gradation

<u>Sieve Size</u>	<u>Percent Passing By Weight</u>
1"	100
1/2"	79-91
No. 4	49-61
No. 16	27-35

¾" Gradation

<u>Sieve Size</u>	<u>Percent Passing By Weight</u>
¾"	100
⅜"	78-92
No. 4	55-67
No. 16	28-38
No. 200	7-11

PART 3 EXECUTION

3.01 PREPARATION OF SUBGRADE

- A. Prior to placing base course materials, the subgrade shall be scarified to a depth of not less than 6", moistened or dried to optimum moisture content, and compacted to at least 95% maximum Modified Proctor Density as determined in accordance with ASTM D1557 (AASHTO T-180), and shall be within 2% of optimum moisture content.
- B. The subgrade shall then be proof rolled in the presence of the Engineer by passing loaded rubber-tired construction equipment uniformly over the surface at a constant rate. At least two (2) passes shall be made over all subgrade areas.
- C. If excessively soft, loose, or disturbed soils are encountered, they shall be removed as directed by the Engineer to a maximum depth of two feet (2') and replaced and recompacted to 95% maximum Modified Proctor Density using approved subgrade stabilizing material.
- D. Ensure subgrade is to required lines and elevations.

3.02 PLACEMENT OF BASE COURSE

- A. Protect against "pumping" moisture to surface by limiting travel on exposed subgrade. Where it is determined by the Owner that construction vehicle traffic (other than proof rolling) has caused subgrade instability, remove disturbed soils and replace with sand backfill at no additional cost to the Owner.
- B. Apply water soluble herbicide for nonselective control of annual and perennial weeds in strict accordance with manufacturers instructions and all laws and regulations.
- C. Place base course material on the prepared and accepted subgrade. The material shall be back-dumped and spread in a uniform lift thickness.
- D. Handle and spread materials in a manner that will prevent segregation of sizes. When

vibrating or other acceptable types of compaction equipment are used, the entire course may be placed in one layer, provided the ability of the equipment to achieve specified compaction to the full layer depth is demonstrated. In no case shall compacted lift thickness be greater than 8".

- E. When base course is constructed in more than one layer, the previously placed layer shall be cleaned of loose and foreign matter. Upper layer of base course shall not be less than 1-1/2", nor shall fine materials be added to reach final grade.
- F. Overstressing the subgrade soil and base course shall be avoided by utilizing equipment in spreading and dumping that exerts only moderate pressures on the soil. Avoid excessive travel on lower base course lifts. Severe rutting, cracking or yielding is an indication of overstressing the soil. Any ruts or cracks which develop in the base course during spreading or compacting shall be repaired as directed at no additional cost to Owner.
- G. Base course shall be compacted to no less than 95% maximum Modified Proctor Density, as determined by ASTM D1557 (AASHTO T-180). Moisture content shall be maintained to within 1.5% of optimum throughout placing and compaction operations.
 - 1. Compaction shall always be commenced along the edge of the area to be compacted and the roller shall gradually advance toward the center of the area to be compacted.
 - 2. Compaction equipment shall be operated along lines parallel or concentric with the centerline of the road being constructed, and no material variation therefrom will be permitted.
- H. Base course shall be substantially true to line and grade as indicated on the drawings. The surface shall be within 1/2" of required grade. Completed thickness of base course shall be within 1/2" of indicated thickness, with average thickness not less than that indicated.
- I. The top surface of compacted base course shall be finished by blading or rolled with equipment designed for that purpose.
- J. Temporary Graded Surface
 - 1. When allowed by the local jurisdiction having authority, where trenches are excavated in paved traffic lanes, the surface course may be temporarily replaced by a surface consisting of base course material. The base course shall be removed and replaced with pavement as soon as conditions permit, or as required by local jurisdiction having authority.
 - 2. The surface shall be maintained to provide for a smooth flow of traffic without holes, bumps, etc., until final acceptance of the work.

3.03 DUST AND SURFACE WATER CONTROL

- A. Dust control measures shall be implemented by application of water to all work areas,

storage areas, haul and access roads, or other areas affected by work.

- B. All work shall be in compliance with the Federal, State and local air pollution standards, and not cause a hazard or nuisance to personnel and the public in the vicinity of the work.
- C. Provide and operate at least one (1) mobile tank sprinkling unit during the contract period.
- D. Other methods of dust control for haul and access roads may include chemical treatment, light bituminous treatment or other method as approved by the Owner.
- E. Surface water shall be controlled to the extent that the areas to receive pavement, walks or slabs are not allowed to become wet from runoff from adjacent areas. Surface water shall be directed away from these areas but not directed toward adjacent property, buildings, or any improvement that may be damaged by water. Surface water shall not be allowed to enter sanitary sewers.

3.04 FIELD QUALITY CONTROL

- A. Testing and inspection of placed Base Course will be provided by the Owner. Tests provided by the Owner are as follows:

<u>Item</u>	<u>Type</u>	<u>Frequency</u>
Base Course Aggregate Sampling	ASTM D75	Each day or 1 test/500 sq. yd., or as required.
Atterberg Limits	ASTM D2419, D423, and D424	As required
Sieve Analysis	ASTM C136	As required
Bearing Ratio	ASTM D1883	As required
Maximum Density	ASTM D1557, Method D	As required
In-place Density	ASTM D2167, D2922 and D3017	As required

- B. If tests indicate that sub-base and/or base course do not meet specified requirements, remove defective work, replace and retest at no cost to Owner.

END OF SECTION

SECTION 321216 - ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Proof roll base course to reveal soft and yielding spots.
- B. Place and compact asphaltic concrete paving.
- C. Pavement Markings.
- D. Protection of newly placed pavement.

1.02 RELATED WORK

- A. Section 013300 – Submittal Procedures: Asphaltic concrete paving mix design.
- B. Section 014000 - Quality Requirements: For testing.
- C. Section 015000 – Temporary Facilities and Controls: For traffic regulation and barricades.
- D. Section 321123 - Base Course

1.03 QUALITY ASSURANCE

- A. Do not place asphaltic concrete paving when the air temperature in the shade and/or the roadbed temperature are below 50 degrees F, or during rain, when the base course surface is wet, or during other adverse weather conditions.
- B. Do not place tack coat when air temperature in the shade and the roadbed temperature are below 50 degrees F, or during rain, fog, or other adverse weather conditions.
- C. All work shall be performed by experienced and qualified workmen with equipment standard with the industry.
- D. Approval by Engineer of sources of supply of materials shall be obtained prior to delivery of materials.
- E. Comply with federal, state and/or local codes and regulations.

1.04 REFERENCES

- A. American Society for Testing Materials (ASTM):

1. D1557, "Tests for Moisture - Density Relationship of Soils using 10 lb (4.5 kg) Rammer in 18 inch (457 mm) Drop".
 2. D1559, "Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus".
 3. D2041, "Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures".
 4. D2170, "Kinematic Viscosity of Asphalts (Bitumens)".
- B. THE ASPHALT INSTITUTE (A.I.) Specification Series No. 2 (SS-2).
- C. American Association of State Highway and Transportation Officials (AASHTO):
1. Materials and compaction tests.
 - a. AASHTO T-180
- D. State of Utah Standard Specifications for Road and Bridge Construction, latest edition including Supplement #2.
1. Section 704.03 Asphaltic Cement.

1.05 SUBMITTALS

- A. An asphaltic concrete paving mix design prepared by a certified laboratory and materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements shall be submitted for review and approval at least two weeks prior to commencement of the work.
- B. Written certification of compliance for pavement marking paint.

1.06 WARRANTY

- A. See General Conditions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Asphaltic cement:
1. Viscosity Graded original, AC-10, conforming to requirements of ASTM D-3381

(AASHTO M-226, Table 2), and Section 704.03 - State of Utah Standard Specifications for Road and Bridge Construction.

2. Shall not foam when heated to 350 degrees F.

B. Mineral aggregate:

1. Shall consist of crushed stone, crushed gravel, or crushed slag, or a combination thereof; free of clay, silt, organic matter or other deleterious materials.
2. Gradation shall be in accordance with the following:

a. 1/2" Gradation

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1/2"	100
#4	60 - 80
#16	28 - 42
#50	11 - 23
#200	5 - 9

3. Course aggregate, retained on the No. 4 sieve shall consist of clean, hard, rough, durable and sound fragments, with not less than 50 percent of particles by weight with at least one mechanically fractured face or clean angular face.
4. Fine aggregate passing the No. 4 sieve may be either a natural or manufactured product. The aggregate shall be clean, hard grained and moderately sharp, and shall contain not more than 2 percent by weight of vegetable matter or other deleterious substances.
5. That portion of the fine aggregate passing the No. 40 sieve shall be nonplastic when tested in accordance with ASTM D-424.
6. The weight of minus 200 mesh material retained in the aggregate, as determined by the difference in percent passing a No. 200 sieve by washing and dry sieving without washing, shall not exceed 6 percent of the total sample weight. That portion of fine aggregate passing the No. 200 sieve shall be determined by washing with water in accordance with ASTM C-117.
7. The aggregate shall be of uniform density and quality and shall have a rodded weight of not less than 100 pounds per cubic foot when tested in accordance with ASTM C-29.

8. The aggregate shall have a percentage of wear not exceeding forty when tested in accordance with ASTM C-131 and C-535.
9. The aggregate shall have a weighted loss not exceeding 12 percent by weight when subject to five cycles of sodium sulfate and tested in accordance with ASTM C-88, D-1073, and D-692.

2.02 ASPHALTIC CONCRETE PAVING MIXTURE

- A. Combine mineral constituents and asphalt cement in proportions per mix design at a central plant to produce an asphaltic concrete pavement mix.
- B. Mix design shall be based on the Marshall Method. The combined mineral aggregate plus any approved additives when mixed with the asphaltic cement in accordance with ASTM D-1559 shall conform to the following requirements:
 1. Marshall Stability: 1200 pounds minimum
 2. Flow (0.01 inch): 10 - 18
 3. Voids Content: 3% - 5%
 4. Asphaltic Cement Content: 5% to 6% by weight
 5. Voids in Mineral Aggregate (VMA): 14% Minimum
- C. The asphaltic cement shall be heated at the mixing plant to a temperature at which it can be applied uniformly to the aggregate.
- D. Coarse and fine aggregate shall be stored separately at the mixing plant in a manner that will prevent intermingling.
- E. When it is necessary to blend aggregates from one or more sources to produce the combined gradation, each source or size of aggregate shall be stockpiled individually. Aggregate from the individual stockpiles shall be fed through separate bins to the cold elevator feeders. They shall not be blended in the stockpile.
- F. Cold aggregates shall be fed carefully to the plant so that surpluses and shortages will not occur and cause breaks in the continuous operation.
- G. The aggregate shall be dried and heated to provide a paving mixture temperature in conformance with placing conditions, but not to exceed 163 degrees C (325 degrees F).

- H. The heated and dried aggregates shall not contain enough moisture to cause the mixture to slump, the asphalt to foam, or the aggregate to segregate during hauling and placing.
- I. The shortest mixing time consistent with satisfactory coating of the aggregate shall be used. The mineral aggregate shall be considered satisfactorily coated with asphaltic cement when all of the particles passing the No. 4 sieve and 96 percent of the particles retained on the No. 4 sieve are coated with asphaltic cement. The required mixing time, as determined above, shall be in accordance with ASTM D-2489.
- J. If a dryer drum mixing process is used, the mineral aggregate shall be considered satisfactorily coated with asphaltic cement when all of the particles passing the No. 4 sieve and 98 percent of the particles retained on the No. 4 sieve are coated with asphaltic cement. The moisture content of the asphaltic cement sampled behind the laydown machine prior to compaction shall not exceed 1 percent by weight.

2.03 TACK COAT

- A. Cut-back asphalt RC or MC 70 or 250.

2.04 MARKING PAINT

- A. Alkyd resin, white in color (No. 780), factory mixed, quick-drying, and non-bleeding, complying with Section 713.07 of the Utah State Department of Transportation Standard Specification for Road and Bridge Construction.

PART 3 EXECUTION

3.01 PREPARATION

- A. Proofroll base course surface. Replace wet, spongy, soft, uncompactable or other unsuitable material with new base course material at no additional cost. Finish and compact repaired area as specified in Section 312300 - Base Course.
- B. Ensure base course surface is to required elevation. Remove loose material from base course surface.
- C. Do not place TACK coat or asphaltic concrete paving until base course installation has been approved by the Construction Manager.

3.02 TRANSPORTING THE ASPHALTIC CONCRETE PAVEMENT

- A. Transport time from the mixing plant to the job site shall not exceed 1 hour.
- B. Hauling truck shall have no direct frame contact with the paver or bear down on the paver

during dumping operations.

3.03 TACK COAT

- A. Prior to placing pavement, tack coat shall be applied to the vertical edges of concrete and "cold" pavement (over 1/2 hour old) which will be in contact with new pavement. Tack coat shall extend 12 inches onto adjacent base course material. The tack coat shall be carefully applied at a rate of 0.15 gal/SY. Tack coat shall also be applied uniformly at the same rate to the horizontal top surface of each lift of bituminous pavement prior to placing the next lift of bituminous pavement to promote a bond between the two courses of pavement. None of the material shall penetrate into the pavement and for this reason the application should be limited.
- B. Prior to applying the material, the surface to be treated shall be swept or flushed free of dust or other foreign material.
- C. Protect all surfaces not required to receive tack coat from any inadvertent application.
- D. The temperature range of the tack coat at the time of application shall be such that the viscosity will be between 50 and 100 centistokes as determined in accordance with ASTM Designation D-2170.
- E. Under no circumstances shall traffic be permitted to travel over the tacked surface. If detours cannot be provided, restrict operation to a width that will permit at least one-way traffic over the remaining portion of the roadbed. If one-way traffic is provided, the traffic shall be controlled in accordance with governing authority.
- F. After application of tack coat, sufficient time shall be given to allow for complete separation of asphalt and water before paving operations begin. The tack coat shall be applied on only as many surfaces as will be paved against in the same day.

3.04 PLACEMENT OF ASPHALTIC CONCRETE PAVEMENT

- A. Place asphalt pavement to provide a compacted depth as indicated on the plans. Placing the pavement shall be a continuous operation. The machine shall spread mixture and shall strike a finish that is smooth, true to cross section, uniform in density and texture, and free from hollows and other irregularities. If any irregularities occur, they shall be corrected before final compaction of the mixture. The paving machine shall be self-propelled, equipped with hoppers, distributing screws, adjustable screeds and equalizing devices, capable of spreading hot asphaltic concrete paving mixtures without tearing, shoving or gouging, and of producing a finished surface of specified quality. Place inaccessible and small areas by hand.
- B. Ensure asphalt pavement temperature is between 150 and 300 centistokes as determined with ASTM D-2170 when mixing with a pugmill, or between 220 degrees F and 260 degrees F

when using the dryer-drum mixing process, immediately after placing and prior to initial rolling.

- C. Ensure joints made during paving operations are straight, clean, vertical and free of broken or loose material. Carefully make joints to insure a continuous bond between old and new pavement, or between successive day's work. A continuous bond between adjoining work is required.
- D. If more than 1/2 hour elapses between adjacent paving passes, the "cold joint" shall have tack coat applied to the "cold" pavement prior to placing the adjacent pass.

3.05 COMPACTION

- A. Roll and compact to specified density before temperature of the mixture drops below 180 degrees F.
- B. Compact asphalt paving course to required density, with a steel wheeled tandem roller, steel three-wheeled roller, vibratory roller, or a pneumatic-tired roller, weighing not less than five tons. Start compaction as soon as pavement will bear equipment without checking or undue displacement. Speed of roller shall be slow enough to avoid displacement of hot mixture, and any displacements occurring as a result of changing the direction of the roller, or from any other cause, shall at once be corrected by the use of rakes and of fresh mixture where required. Ensure each pass of roller overlaps previous passes by at least 1/2 of the roller width to ensure smooth surface free of roller marks. Keep roller wheels sufficiently moist so as not to pick up material. Rolling shall continue until roller marks are eliminated and no further compression is possible. The finished compacted pavement shall have a density of 93% minimum, (no test less than 93% of the density determined in accordance with ASTM D-2041), as determined by ASTM D2170.
- C. Leave pavement with a uniform, dense surface.
- D. Perform hand tamping in areas not accessible to rolling equipment. Thorough compaction must be achieved, and joints between curbs, headers, manholes and similar structures must be effectively sealed.
- E. Do not allow vehicular traffic on newly paved areas until surface has cooled to atmospheric temperature.

3.06 PAVEMENT MARKING

- A. Unless otherwise directed by Construction Manager, the painting of parking stripes shall be commenced not earlier than 15 days after completion of the asphaltic concrete paving.
- B. Prior to painting, broom or sweep the surface to remove dirt, loose stones or other foreign material. Solvent material that will damage pavement shall not be used as cleaning agents.

END OF SECTION

SECTION 321613 - CURBS, GUTTERS, DRIVE APRONS AND WALKS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Provide all equipment, materials, labor, tools, and transportation and other items required to provide and install subgrade preparation, drainage course placement, formwork, and placement and finishing of portland cement concrete curbs, gutters, walks and drive aprons.
- B. Protection of newly constructed curbs, gutters, drive aprons and walks.
- C. Curing provisions.

1.02 RELATED WORK

- A. Section 321123 - Base Course
- B. Section 033000 - Cast in Place Concrete

1.03 QUALITY ASSURANCE

- A. Use workmen thoroughly trained and experienced in placing and finishing the type of work specified.
- B. Comply with applicable federal, state, and local codes and regulation.
- C. Comply with hot or cold weather requirements.
- D. Concrete work shall be warranted against defects in materials or workmanship for a period of two (2) years, subject to applicable laws and regulations. In no case shall the Work be warranted for less than one (1) year.

1.04 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. Manual of Concrete Practice, 1985, Part 2:
 - a. ACI 305R-77- Hot Weather Concreting
 - b. ACI 306R-78 - Cold Weather Concreting
 - c. ACI 318 - Building Code Requirements
- B. American Society for Testing and Materials (ASTM)
 - 1. D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction

- 2. C150 - Portland Cement
- 3. C33 - Concrete Aggregates
- 4. C94 - Ready Mixed Concrete
- C. American Association of State Highway and Transportation Officials (AASHTO)
- D. Federal Standard (FS)

1.05 SUBMITTALS

- A. Submit concrete trip tickets to Owner's representative at the time of delivery to the site.
- B. Submit mix design in accordance with Section 013300.
- C. Submit construction, expansion, and contraction joint layout plan for approval.
- D. Submit manufacturers data for all products proposed.

1.06 DELIVERY AND HANDLING

- A. Ready mixed concrete shall be delivered to the site only in such quantities as are required for immediate use. The maximum allowable time between charging of the material in the mixing drum and final placing shall be not more than ninety (90) minutes when ambient temperatures are below 80 Degrees F and not more than sixty (60) minutes when ambient temperatures are above 80 Degrees F.
- B. Concrete which has reached initial set prior to placement, or retempered concrete is not acceptable, shall not be used in the Work, and shall be promptly removed from the project site.

1.07 PROJECT CONDITIONS

- A. Concreting operations shall not be performed when air temperature at the project site falls below 40 Degrees F.
- B. Concreting operations shall not be performed when air temperature at the project site rises above 105 Degrees F.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS AND MIXTURE

- A. Shall be in accordance with Section 033000.
- B. Cement shall comply with the requirements of ASTM C150, Type II.

- C. Coarse Aggregate shall comply with the requirements of ASTM C33 and Section 033000 of these specifications.
- D. Fine Aggregate shall comply with the requirements of ASTM C33 and Section 033000 of these specifications.
- E. Admixtures shall not be allowed in portland cement concrete with the following exceptions:
 - 1. Air Entraining Admixture shall comply with the requirements of ASTM C260.
- F. Concrete curing compound shall comply with ASTM C309, Type II, Class A and shall restrict moisture loss to 0.055 gr./sq.cm when applied at a rate of 200 sq.ft./gal.
- G. Mix design shall comply with Section 033000 of these specifications.

2.02 JOINT MATERIALS

- A. Filler material shall be pre-formed, non-extruding resilient type conforming to the requirements of ASTM D544 of appropriate thickness to fill joint.
- B. Joint sealant shall be polyurethane based, self leveling, one part elastomeric sealant complying with the requirements of FS-TT-S00230 Class A, Type I unless Type II is recommended for the intended application by the sealant manufacturer.
- C. Select joint materials of sufficient strength, hardness and durability to withstand stiletto heel traffic without damage or deterioration.

2.03 REINFORCEMENT

- A. Reinforcement shall comply with the requirements of Section 033000 of these specifications.

2.04 FORMWORK

- A. Formwork shall comply with the requirements of Section 033000 of these specifications.

2.05 EQUIPMENT

- A. Equipment for placing concrete shall comply with the requirements of Section 033000 of these specifications.

PART 3 EXECUTION

3.01 PREPARATION

- A. Remove all wood scraps, ice, snow, frost and debris from the areas in which concrete will be placed. Concrete shall not be placed on frozen ground or in standing water.

- B. Thoroughly clean the areas to ensure proper placement and bonding of concrete.
- C. Thoroughly wet the forms (except in freezing weather), or oil them; remove all standing water.
- D. Thoroughly clean all transporting and handling equipment.
- E. Notify the Owner at least 24 hours before placing concrete.
- F. Obtain the Engineer's approval of location of construction, expansion, or control joints prior to the start of concrete placement.
- G. Verify that reinforcement is free of loose mill scale, mud, paint, oil, grease, or other materials which may hinder proper bonding of concrete to reinforcement.

3.02 PLACING STEEL REINFORCEMENT

- A. Steel reinforcement shall be placed in accordance with the requirements of Section 032000 of these specifications.

3.03 PLACING CONCRETE

- A. Concrete shall be placed in accordance with the requirements of Section 033000 of these specifications.

3.04 SIDEWALK, DRIVEWAY, AND CURB AND GUTTER JOINTS

- A. Locate all joints according to the approved joint plan, making all joints perpendicular and straight.
- B. Joints for existing structures or paving removed or damaged as a result of the Work shall be replaced, matching joints in original structure as closely as possible.
- C. Expansion Joints
 - 1. Expansion joints in sidewalks shall be one half inch ($\frac{1}{2}$ ") in thickness and shall be placed where sidewalk joins existing walks, fixed objects, and at curbs at all handicap ramps using premolded expansion joint filler. Expansion joints shall not be spaced greater than 50' on center. Dowel bars are not required at expansion joints unless indicated on the drawings.
 - 2. Expansion joints in curb and gutter shall be one half inch ($\frac{1}{2}$ ") in thickness and shall be placed between curb and gutter and storm drain structures, at changes in direction, or at intervals not exceeding 50' using premolded expansion joint filler.
 - 3. Joint sealant shall be installed over all expansion joints. Provide and install bond breaker per the manufacturer's recommendations.
- D. Contraction Joints

1. Sidewalks
 - a. Contraction joints shall be installed at intervals equal to the width of sidewalk using steel plates not less than 1/8" nor more than 1/4" in thickness.
 - b. Remove steel plates once concrete has reached initial set.
 - c. Tooled joints shall be rounded to provide a neat, workmanlike appearance.
 - d. Joints may be provided by cutting into fresh concrete to a minimum depth of 1/4 of the walk thickness. Cut joints shall be straight and perpendicular to walk.
2. Curb and Gutter
 - a. Contraction joints shall be installed according to the approved joint plan using steel templates not less than 1/8" nor more than 3/16" in thickness.
 - b. Remove steel templates once concrete has reached initial set.
 - c. Curb and gutter placed by slipform methods shall have joints installed every 10' by cutting into fresh concrete to a depth not less than 1-1/2". Round such joints to provide a neat workmanlike appearance.

- E. Inspect joints upon removal of forms to verify that concrete or mortar has not sealed across the joint. Cut neatly and remove any such concrete or mortar in the joint.

3.05 HOT WEATHER CONCRETING

- A. Hot weather concreting shall be performed in accordance with Section 033000 of these specifications.

3.06 COLD WEATHER CONCRETING

- A. Cold weather concreting shall be performed in accordance with Section 033000 of these specifications.

3.07 FINISHING

- A. Concrete surfaces shall be finished smooth and true to grade by float. The finishing shall commence immediately after the concrete is placed and shall progress at a rate equal to the paving operation. Any delay in excess of thirty minutes in performing the preliminary finishing shall constitute cause for shutting down the mixing operations until the finishing is resumed.
- B. Hand methods of strike off and consolidation will only be permitted when the width of pavement to be constructed is less than 10 feet or at rounded intersection where the use of machine finishing is impractical.
- C. While the concrete is still plastic the entire slab surface shall be tested by the Contractor for trueness with an accurate 10 foot straightedge. Any depressions found shall be immediately filled with fresh concrete, struck off, reconsolidated, and finished. High spots shall be struck off and refinished.

- D. In advance of curing operations the pavement shall be textured by brooming. Owner shall be notified 24 hours in advance of placing and brooming operations in order to be present to review and recommend modifications to placement and finishing.
- E. Finished Surface
 - 1. The finished surface shall be true to grade and cross section, free from ruts, humps, depressions or other irregularities. The surface shall not deviate from line and grade by more than 1/8" in 10'. The determination of compliance with smoothness may be made with a straightedge or string line at the option of the Engineer. Any irregularities found shall be corrected by the Contractor using suitable grinding or grooving tools and equipment.
 - 2. The grinding tool shall consist of a machine equipped with cutting wheels mounted on a horizontal shaft. The grinding action shall be conducted parallel to the centerline. Grinding operations may be deferred, as directed by the Engineer, whenever tearing of aggregate with the surface occurs and shall not be resumed until the concrete has hardened sufficiently to avoid tearing.
 - 3. The finished surface across contact joints shall not deviate from a straight line by more than 1/8" in 12" when tested with a straightedge. The Contractor shall take the necessary precautions to prevent slumping of the edge of the concrete at contact joints.
 - 4. Line and Grade Control:
 - a. Contractor shall establish references at suitable intervals for line and grade control of the placing operations.
 - b. Contractor shall furnish, place and maintain such supports, wire devices and materials that may be required to provide continuous line and grade reference controls to the placing machine, trimmers, or paver.

3.07 CURING

- A. Protect placed concrete from the effects of hot or cold weather as required under Section 03300 of these specifications.
- B. Membrane Curing Compound
 - 1. Surfaces of newly placed or exposed concrete shall be kept moist or wet until the curing compound is applied. The curing compound shall be applied immediately after all patching or surface finishing has been completed.
 - 2. The curing compound shall be delivered to the work in ready mixed form. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. The compound shall not be diluted or altered in any manner.

3. Curing compound that has become chilled to such an extent that it is too viscous for satisfactory application shall be warmed to a temperature not exceeding 100 degrees F, unless otherwise specified by the manufacturer's recommendations.
4. The curing compound shall be applied to the exposed surface at a uniform rate of 1 gallon per 100 square feet, unless otherwise specified by the manufacturer's recommendations.
5. In the event that the application of curing compound is delayed, the application of water spray, ponding, or soaked tarps shall be started immediately and shall be continued until application of the compound is started or resumed.

3.08 PROTECTION

- A. Contractor shall protect the concrete against all damage and markings.
- B. Erect and maintain suitable barricades and barriers to protect the finished surface. Any sections damaged from traffic or other causes prior to final acceptance shall be removed, replaced, or repaired to the Owner's satisfaction at no additional expense to the Owner.
- C. Concrete surface shall be protected against pitting or damage due to rain.

END OF SECTION

SECTION 323113 - CHAIN LINK FENCE AND GATES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and services necessary for complete installation of chain link fence, gates and accessories.

1.02 REFERENCES

- A. Comply with regulations and referenced portions of American Society of Testing Materials (ASTM).

1.03 SUBMITTALS

- A. Provide manufacturer's specifications for all materials prior to ordering and delivery to the site.

PART 2 PRODUCTS

2.01 CHAIN LINK FABRIC

- A. Steel wire helically wound and interwoven to provide a continuous mesh without knot or ties within the mesh.
- B. Mesh size to be 2 inches measured between parallel wires in any direction. Openings to form a diamond shape.
- C. Steel wire to be 9 gauge with a breaking strength as shown in Table 1 of ASTM A-392 Method A-370.
- D. Knuckle both selvages of 60 inch fabric.
- E. Knuckle bottom and twist top of fabric 72 inches high and over.
- F. Hot-dip zinc coat fabric, after fabrication, according to ASTM A-392 Class 1. Weight of zinc coating not less than 1.2 ounces per square foot of actual surface covered. Zinc to conform to ASTM B6.

2.02 POSTS, RAILS AND BRACES

- A. All posts and braces to conform to Federal Specification RR-F-191/3C Class 1, Grade A.
- B. Steel pipe to be heavy wall, round according to ASTM A-120 (Schedule 40).

- C. Piping, tubing and braces to meet the Salt Spray test according to ASTM B-117.
Exterior - 1,000 hours with maximum 5% Red Rust
Interior - 450 hours with maximum 5% Red Rust
- D. Posts to have the following dimensions and weights:

<u>OUTSIDE DIAMETER</u> <u>(INCHES)</u>	<u>WALL THICKNESS</u> <u>(INCHES)</u>	<u>WEIGHT</u> <u>(LB/FT)</u>
1 3/8"	.095	1.24
1 5/8"	.110	1.82
1 7/8"	.120	2.28
2 3/8"	.130	3.12
2 7/8"	.160	4.64
4"	.160	6.56

- E. Posts and line caps or combination tops with supporting arms shall conform to ASTM F-626.

2.03 TENSION WIRES AND WIRE TIES

- A. Steel tension wire shall be 7 gauge, 0.177 inch minimum diameter, marcelled or crimped coil spring hard-tempered carbon steel wire.
- B. Wire ties and C-rings shall conform to ASTM F-626.
- C. Zinc coat of 1.2 ounces per square foot of surface area per ASTM A-116 Class II.

2.04 TRUSS OR TENSION RODS

- A. Provide a rod not less than 3/4 inch nominal diameter.
- B. Adjustment shall be provided by a galvanized turnbuckle for each rod.

2.05 TENSION BARS, BRACES, AND TENSION BANDS

- A. Conform to requirements of ASTM F-626.
- B. Tension bars to be not less than 1/4" by 3/4" and not shorter than 2 inches less than the nominal height of the fabric.

2.06 SECURITY TOPPINGS

- A. None

2.07 GATES

- A. Gate frames to be constructed of round schedule 40 pipe use 1.900 inch O.D. pipe to be zinc coated per ASTM A-120.
- B. Provide horizontal, vertical and diagonal truss bracing to prevent sag or twist.
- C. Steel welds to be painted with zinc based paint.
- D. Gate fabric to meet the requirements of article 2.01 this section.

2.08 HINGES

- A. Of adequate strength for gate with large bearing surfaces for clamping. in position.

2.09 LATCHES AND STOPS

- A. For double-leaf gate, provide fork type latch with center drop rod or plunger bar type of full gate height.
- B. Provide for locking of gates in closed position with the use of a padlock.
- C. Center stop shall consist of a device set in concrete.
- D. Submit detailed information for approval.

2.10 ZINC COATING

- A. All steel and iron to be coated per ASTM A-392 Class 1. Weight of zinc coating to be 1.2 ounces per square foot of surface area.

PART 3 EXECUTION

3.01 POST INSTALLATION

- A. Space line posts equidistant at intervals not exceeding 10 feet.
- B. Terminal posts (end, corner and gate) to be set at beginning and end of continuous length of fence and at abrupt changes in vertical (30 degrees or more) and horizontal alignments.
- C. Set posts in holes four times the diameter of the largest cross-section of the post. Backfill concrete (2,500 psi) into the excavation and extend 2 inches above grade. Crown the concrete at the top to shed water and extend the footing a minimum of 2 inches below the bottom of the post. Footings shall not be less than 36 inches deep.
- D. Corner, slope and gate posts shall be braced with a diagonally, securely fastened between the terminal post and the adjacent line post or its footing or a footing of equal size. There shall be no more than a 50 degree angle between the brace and the ground.

- E. Posts to be vertical in position, plumb and in line.
- F. Extend every third post to allow securing of security topping on 7 foot fence.

3.02 TENSION WIRE INSTALLATION

- A. All fence shall be installed with top and bottom tension wires.
- B. Fasten tension wires within the top and bottom 6 inches of fabric.
- C. Tension wire to be taut and free of sag.

3.03 CHAIN LINK FABRIC INSTALLATION

- A. Fabric to be placed on the outside of area enclosed.
- B. Secure fabric at one end and place with sufficient tension to remove slack.
- C. Install fence fabric 2 inches above ground level.
- D. Fasten fabric to line post at intervals not exceeding 15 inches.
- E. Fasten fabric to tension wire with C-rings, intervals not to exceed 24 inches.
- F. Fabric to have a continuous mesh. Weave rolls together using a single picket if needed.

3.04 GATE AND HARDWARE INSTALLATION

- A. Hinges shall not twist or turn under the gate action.
- B. Gates shall be capable of opening and closing easily by one person.
- C. Install gate on hinges to prevent removal by lift-off.
- D. Locking devices shall be constructed so that the center drop rod or plunger bar can not be raised when locked.

END OF SECTION

SECTION 330525 - RESTORATION OF EXISTING IMPROVEMENTS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Contractor shall provide all materials, labor, equipment, transportation, and other items required to restore existing improvements dislocated, damaged, or removed as indicated or as required to accomplish Work of other sections of these specifications. All restoration Work shall be in accordance with applicable regulations and as specified herein.
- B. Restoration of existing improvements includes, but is not limited to the following:
 - 1. General Restoration Requirements
 - 2. Restoration or replacement of gravel, asphaltic concrete, or portland cement concrete pavements, including base course and striping.
 - 3. Portland cement concrete curbs, gutters, sidewalks, and driveways
 - 4. Miscellaneous improvements

1.02 RELATED WORK

- A. Section 312300 - Excavating, Backfilling and Compaction
 - 1. Compaction requirements under paving and landscaped areas, removal of unsuitable materials.
- B. Section 331100 - Potable Water Distribution Systems
 - 1. Materials and installation practices for valves, hydrants and water appurtenances.
- C. Section 333100 - Sanitary Sewer Systems
 - 1. Materials and installation practices for sewer laterals, manholes and appurtenances.
- D. Section 334100 - Storm Sewer Systems
 - 1. Materials and installation practices for sewer laterals, manholes and appurtenances.
- E. Section 321613 – Curb & Gutter, Sidewalks and Drive Approaches
 - 1. Materials and installation practices for concrete pavements.

1.03 REFERENCES

- A. The applicable provisions of the latest editions of the References listed below shall govern the Work covered under this Section, unless there is a conflict between said References and the requirements of this Section. In the case of such a conflict, the requirements of this Section shall apply.
- B. APWA Manual of Standard Specifications, 2007 Edition.
- C. American Society for Testing and Materials (ASTM)
- D. American Association of State Highway and Transportation Officials (AASHTO)
- E. American Concrete Institute (ACI)
- F. Concrete Reinforcing Steel Institute (CRSI)

1.04 SUBMITTALS

- A. Submit shop drawings, manufacturer's literature, certifications, and other product data in accordance with Section 013000 - Submittals.
- B. Required submittals include, but are not limited to:
 - 1. Manufacturer's recommended transportation, unloading, and storage requirements as well as installation guides and instructions for materials provided as part of this Work.
 - 2. Evidence of materials conformance with applicable requirements as well as these specifications.
 - 3. Dimensional information for pipes, valves, fittings, castings, structures and other items provided as part of this Work.
- C. Contractor shall maintain accurate construction record drawings for items restored as part of this Work, but covered by subsequent landscaping, paving or as a result of Work of other sections of these specifications. These records shall be submitted to Contracting Officer for approval prior to application for final payment.

1.05 QUALITY ASSURANCE

- A. Transportation, handling, storage and installation practices shall be in accordance with manufacturer's recommended practice for materials provided as part of this Work.

- B. Use adequate numbers of skilled workmen who are trained and experienced in the type of construction required.
- C. The quality of the finished restored improvement, as determined by the Government, shall be of equal or better quality than was said improvement prior to being damaged or removed.
- D. Salt Lake City requirements shall govern for all work in Salt Lake City road right-of-ways:
 - 1. All work shall conform to the applicable standards, regulations, and requirements of the Salt Lake City Public Works Department.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Contractor shall be responsible for proper transportation ,unloading, handling, storage, and security of all equipment and materials to be provided as part of this specification in accordance with manufacturer's recommendations.
- B. Materials shall be stored in such a manner as to prevent damage or degradation. Any materials damaged prior to installation shall be removed from the project and replaced with new materials at no additional cost. Lost or stolen materials shall be replaced at no additional cost.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers providing materials or equipment as part of this specification shall have a minimum of five (5) years experience in the design, manufacture, testing and support of such materials.
- B. Manufacturers shall provide, upon request, verification of a consistent record of meeting or exceeding materials or performance standards as specified herein.

2.02 MATERIALS - GENERAL

- A. Materials shall be as required to complete the restoration of existing improvements, and shall be at least equal to original improvement at the time of damage or removal, as determined by the Government of said improvement, and shall match original construction in finish and dimension.
- B. Materials shall be in accordance with requirements of local jurisdiction having authority. Obtain approval of all materials from local jurisdiction having authority prior to ordering.

2.03 UNTREATED BASE COURSE

- A. APWA Manual of Standard Specifications, 2007 Edition.
- B. Section 321123 – Grade 1 or Grade $\frac{3}{4}$.

2.04 BITUMINOUS SURFACE COURSE

- A. APWA Manual of Standard Specifications, 2007 Edition.
- B. Section 321216 –Grade DM-1/2, AC-10

2.05 PORTLAND CEMENT CONCRETE

- A. APWA Manual of Standard Specifications, 2007 Edition.
- B. Section 033004 - Class 4000

1. Coarse Aggregate Size: 3/4" to No. 4
2. Maximum Water/Cement: 5.0 gallons/Sack
3. Minimum Cement Content: 6.5 Sacks/Cubic Yard
4. Required Mix Design Compressive Strength: 5210 psi
5. Minimum 28-day Compressive Strength: 4000 psi

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that Work covered under other sections of these specifications is complete to the point that Work covered under this section may properly commence without hindering or damaging Work of other trades. Do not proceed with construction until unsatisfactory conditions have been corrected.
- B. Verify that Work performed under other sections of these specifications has been adequately inspected, tested and accepted prior to covering up that Work as part of the Work specified under this section.
- C. Carefully examine restoration areas, verifying dimensions, materials and other restoration requirements with Contracting Officer and Government prior to beginning Work covered under this section.

3.02 METHODS AND PROCEDURES

- A. General Requirements

1. Contractor shall obtain all permits necessary for the restoration of existing surface improvements.
2. Contractor shall protect all public and private property adjacent to the work. Exercise due caution to avoid damage to such property.
3. All improvements damaged or removed shall be restored in accordance with local jurisdiction having authority. In case of conflict between these specifications and local authority specifications, the local authority shall govern.
4. Repair or replace all existing surface improvements, which were damaged or removed as a result of operations of Work under this contract. Restoration shall be of at least equal quality and identical in dimension to original improvement unless specifically specified otherwise.

3.03 INSTALLATION

A. Gravel Surfaced Areas

1. Where trenches are excavated through gravel surfaced areas such as roads and driveways and other areas, the gravel surface shall be restored by placing road base material upon a prepared subgrade.
2. Subgrade preparation shall conform to APWA, 2007, Section 321123.
 - a. Average of field density determinations shall be 95% of the maximum dry density, with no determination lower than 92%.
 - b. The maximum dry densities shall be determined in accordance with the following:
 - i. A-1 Soils: AASHTO Designation T-180, Method D.
 - ii. All other Soils: AASHTO Designation T-99, Method D.
3. Thickness of road base surface shall be 6 inches or shall match existing, whichever is greater.
4. Compaction of road base surface shall conform to APWA Manual of Standard Specifications, 2007 Edition, Section 312323, Compaction.

B. Asphaltic Concrete Surfaced Areas

1. Where trenches are excavated through asphaltic concrete surfaced areas such as roads, driveways or parking areas, the surface shall be restored by preparing the subgrade, placing base course(s), placing tack and prime coats, and placing the asphaltic concrete surface course(s).

2. Subgrade preparation shall conform to the APWA Manual of Standard Specifications, 2007 Edition, Sections 312323 Backfilling for Structures and Section 312326 Compaction.
 - a. Average of field density determinations shall be 95% of the maximum dry density, with no determination lower than 92%.
 - b. The maximum dry densities shall be determined in accordance with the following:
 - i. A-1 Soils: AASHTO Designation T-180, Method D.
 - ii. All other Soils: AASHTO Designation T-99, Method D.
3. Thickness of base course shall be 8 inches, shall match existing, or shall be as required by local authority having jurisdiction, whichever is greater.
4. Placing and compaction of base course shall conform to Section 321123 of the APWA Manual of Standard Specifications, 2007 Edition.
5. Tack Coat: APWA, 2007 Edition, Section 321214
 - a. Tack coat shall be applied at the rate of 0.05 to 0.15 gal/SY. A hand sprayer or brush shall be used to apply tack coat to vertical faces of previously constructed bituminous pavement (over 1/2 hour hence) prior to placing an adjacent or parallel pass, curbs, gutters, slab edges, and all structures to be in actual contact with the bituminous pavement. Tack coat shall also be applied uniformly at the same rate to the horizontal top surface of each lift of bituminous pavement prior to placing the next lift of bituminous pavement to promote a bond between the two courses of pavement. None of the material shall penetrate into the pavement and for this reason the application should be limited.
 - b. Prior to applying the material, the surface to be treated shall be swept or flushed free of dust or other foreign material.
 - c. Protect all surfaces not required to receive tack coat from any inadvertent application.
 - d. The temperature range of the tack coat at the time of application shall be such that the viscosity will be between 50 and 100 centistokes as determined in accordance with ASTM Designation D-2170.
 - e. Under no circumstances shall traffic be permitted to travel over the tacked surface. If detours cannot be provided, restrict operation to a width that will permit at least one-way traffic over the remaining portion of the roadbed. If one-way traffic is provided, the traffic shall be controlled in accordance with governing authority.

- f. After application of tack coat, sufficient time shall be given to allow for complete separation of asphalt and water before paving operations begin. The tack coat shall be applied on only as many surfaces as will be paved against in the same day.
 - 6. Mixing, placing, spreading and compaction of bituminous surface course shall conform to APWA Manual of Standard Specifications, 2007 Edition, Section 321205, Asphalt Concrete, and Section 321216, Plant Mix Asphalt Paving.
- C. Concrete Curbs, Gutter, Sidewalks and Driveways. APWA, 2007 Edition, Section 321613, Driveway, Sidewalk, Curb and Gutter.
 - 1. Shall be removed and replaced to the next joint or scoring lining beyond the actually damaged or broken sections; or in the event that joints or scoring lines do not exist or are three or more feet from the removed or damaged section, the damaged portions shall be removed by saw cutting full-depth.
 - 2. All new concrete shall match, as nearly as possible, the appearance of adjacent concrete improvements. Where necessary, lampblack or other pigments shall be added to the new concrete to obtain the desired results.
 - 3. Concrete forms shall be true to line and of sufficient strength to ensure against bulging or displacement.
 - 4. Contraction and expansion joints shall match original construction in placement and size, unless otherwise required by local jurisdiction having authority.
 - 5. Reinforcement shall be replaced as in original construction, unless otherwise required by local jurisdiction having authority, and shall be installed in accordance with applicable CRSI and ACI Standards.
 - 6. Finishing and curing shall be in accordance with local jurisdiction having authority.
- D. Miscellaneous Restoration Items
 - 1. All other improvements interrupted or removed to permit the construction specified herein shall be restored. Miscellaneous improvements to be restored shall include, but shall not be limited to, the following:
 - a. Culverts
 - b. Fences
 - c. Utilities

3.04 PROTECTION

- A. Provide barricades and restrict access as appropriate to prevent damage to Work in place.
- B. Contractor shall be responsible for protection of Work in place against displacement, damage, loss or theft until Government's acceptance. Any Work installed and subsequently damaged, lost or displaced shall be repaired or replaced to the Government's satisfaction at no additional cost.

3.05 CLEANING

- A. Thoroughly clean, rake, wash and/or flush all restoration Work prior to submitting for Government's acceptance.

3.06 TESTING

Not Used

END OF SECTION

SECTION 331100 - POTABLE WATER DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Contractor shall provide all materials, labor, equipment, transportation, and other items required to provide and install potable water distribution systems as required by applicable codes and regulations, and as specified herein.
- B. Potable water distribution systems shall include, but not be limited to the following.
 - 1. Potable water transmission or distribution piping.
 - 2. Valves, fittings, and accessories.
 - 3. Thrust blocking and corrosion protection.
 - 4. Hydrostatic and Leakage testing.

1.02 RELATED WORK

- A. Section 312200 - Excavation, Backfill and Compaction.
 - 1. Excavation of trenches, pipe bedding and backfill, compaction of backfill
- B. Section 221115 - Disinfection of Water Distribution Systems
- C. Division 033000 - Concrete
 - 1. Thrust blocks, structures associated with water systems.
- D. Section 099113 – Exterior Painting
 - 1. Hydrant, valve and appurtenant item painting

1.03 REFERENCES

- A. The applicable provisions of the latest editions of the References listed below shall govern the Work covered under this Section, unless there is a conflict between said References and the requirements of this Section. In the case of such a conflict, the requirements of this Section shall apply.
- B. American Water Works Association (AWWA)
- C. American Society for Testing and Materials (ASTM)

- D. American National Standards Institute (ANSI)
- E. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. Standard Specifications for Highway Bridges
- F. Ductile Iron Pipe Research Association (DIPRA)
- G. Uni-Bell PVC Pipe Association

1.04 SUBMITTALS

- A. Submit shop drawings, manufacturer's literature, certifications, and other product data in accordance with Section 013000 - Submittals.
- B. Required submittals include, but are not limited to:
 - 1. Evidence of materials conformance with these specifications.
 - 2. Manufacturer's recommended transportation, unloading and storage requirements. Manufacturer's installation guides and instructions.
 - 3. Dimensional information for pipe, valves, fittings, castings, and structures.
- C. Contractor shall maintain accurate construction record drawings of all as-built valve, fitting, and line locations, manhole locations, pipe lengths, and other relevant data and shall submit these records to the Engineer for approval prior to application for final completion.

1.05 QUALITY ASSURANCE

- A. Transportation, handling, storage and installation practices shall be in accordance with manufacturer's recommended practice for materials provided as part of this Work.
- B. Contractor's personnel shall be experienced in the installation of materials provided as part of the Work, and shall comply with manufacturer's recommended practices during handling, placement and installation of such materials.
- C. Pipe, valve and appurtenant materials and Workmanship shall be in accordance with ANSI/NSF 61 and AWWA Standards as applicable.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Contractor shall be responsible for proper transportation, unloading, handling, storage and security of all equipment and materials to be provided as part of this specification in accordance with manufacturer's recommendations.

- B. Materials shall be stored in such a manner as to prevent damage or degradation. Any materials damaged prior to installation shall be removed from the project and replaced with new materials at no additional cost. Lost or stolen materials shall be replaced at no additional cost.
- C. Load and unload pipe, fittings, specials, valves and accessories by lifting with hoists or skidding so as to avoid shock or damage. Do not skid or roll pipe on skidways against pipe already on the ground.
- D. Each length of pipe shall be unloaded opposite or near the place where it is to be laid in the trench.
- E. Polyvinyl Chloride (PVC) piping, fittings, and materials shall be protected during storage from ultraviolet and ozone degradation. Noticeably faded materials shall not be installed and shall be promptly removed from project site.
- F. At times when pipe laying is not in progress, the open end(s) of pipe in the trench shall be closed by a watertight plug.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers providing materials or equipment as part of this specification shall have a minimum of five (5) years in the design, manufacture, and testing of such materials.
- B. Manufacturers shall provide, upon request, verification of a consistent record of meeting or exceeding materials or performance standards as specified herein.
- C. Allowable Manufacturers - Subject to compliance with specified requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:
 - 1. Water System Piping
 - a. Ductile Iron (DIP)
 - i. Pacific States Cast Iron Pipe Company, Provo, Utah
 - ii. United States Pipe and Foundry Company, Birmingham, Alabama
 - iii. Tyler Pipe, Tyler, Texas (Fittings Only)
 - b. Polyvinyl Chloride (PVC)
 - i. J - M Manufacturing Company, Livingston, New Jersey
 - ii. Extrusion Technologies, Incorporated, Denver, Colorado
 - iii. Pacific Western Extruded Plastics Company, Eugene, Oregon

2. Valves
 - a. Gate Valves
 - i. Mueller Company, Decatur, Illinois
 - ii. Clow/McWane Incorporated, Birmingham, Alabama
 - iii. American Darling
 - b. Tapping Sleeves and Valves
 - i. Mueller Company, Decatur, Illinois
 - ii. Clow/McWane Incorporated, Birmingham, Alabama

2.02 POTABLE WATER SYSTEM PIPING

- A. Water system piping shall be of the size, type, and class indicated on the drawings and as specified herein.
- B. Ductile Iron Pipe and Fittings
 2. Ductile iron fittings shall comply with the requirements of the following:
 - a. AWWA/ANSI C110/A21.10 - American National Standard for Ductile Iron and Grey Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.
 - b. AWWA/ANSI C153/A21.53 - American National Standard for Ductile Iron Compact Fittings, 3 in. through 24 in. and 54 in. through 64 in. for Water Service.
 3. Ductile iron pipe and fittings shall be cement mortar lined and shall have a bituminous seal coat in accordance with the requirements of AWWA/ANSI C104/A21.4 - American National Standard for Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
 4. Joints and gaskets shall be in accordance with AWWA/ANSI C111/A21.11 American National Standard for Rubber Gasketed Joints for Ductile Iron Pressure Pipe and Fittings.
 5. Flanged pipe shall be in accordance with AWWA/ANSI C115/A21.15 - American National Standard for Flanged Ductile Iron Pipe with Ductile Iron or Grey Iron Threaded Flanges.
- C. Polyvinyl Chloride Pipe
 1. PVC pipe shall be manufactured from virgin Class 12454A or 12454B materials as defined by ASTM D1784

2. PVC pipe and fittings shall be designed and manufactured in accordance with the following requirements:
 - a. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution.

2.03 CORROSION PROTECTION

- A. Bolts: Apply 2 coats of Coal for Mastic (Kopper 50 or equal) to all exposed surfaces of bolts and to all bolt threads after installation of piping, fittings, valves, and couplings.
- B. Fittings, valves, and specialties shall be tape wrapped with Polyken 930 filler tape for filling voids and with Polyken 930 tape to cover.
- C. Polyethylene encasement, if required, shall conform to AWWA/ANSI C105/A21.5 - American National Standard for Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.

2.04 VALVES

- A. Gate valves:
 1. Shall be iron body, fully bronze mounted, resilient seat non-rising bronze stem with mechanical joint ends, except as otherwise specified or shown on the Drawings.
 2. Gate valves shall conform to the following requirements:
 - a. AWWA C509 - Resilient Seated Gate Valves for Water Supply Service.
 3. All valves shall be provided with a 2" square operating nut for key operation from ground surface and open to the left, unless handwheels are indicated.
 4. Valve body and gates shall be rated to a design working pressure of 200 psig for valves up to 12", and 150 psig for valves of 16" or greater. All valves shall be factory tested to twice the rated working pressure.
 5. Gate valves for potable water service shall be epoxy lined in accordance with AWWA/ANSI C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
 6. Gate valves shall be similar and equivalent to that produced by the following manufacturers:
 - a. Mueller Cat. No. A-2370 or A-2380
 - b. Clow Cat. No. F-6100 or F-5000 Series
- B. Tapping valves and sleeves:

1. Tapping valves shall have large diameter seat rings to permit entry of tapping machine cutters. Inlet shall be flanged. Outlet shall suit branch piping and shall include the required flange for tapping machine adapter connection. Tapping valves shall conform to the applicable requirements for gate valves as specified herein.
2. Tapping sleeves shall be suitable for assembly around the existing main. Body shall be high strength ribbed construction. End gaskets shall be sized to suit the existing main.
3. Tapping valves and sleeves shall similar and equivalent to those produced by the following manufacturers:
 - a. Clow Cat. No. F-5205
 - b. Mueller Cat. No. H-600 Series

2.05 VALVE BOXES

- A. Shall be suitable for HS-20 (AASHTO) traffic loading.
- B. Shall be furnished and installed over each line valve and over each auxiliary hydrant valve. All buried valves shall be installed complete with two-piece, cast iron, screw type, 5-1/4 inch shaft valve box.

2.06 HYDRANTS

- A. Hydrants shall be dry barrel type, of cast or ductile iron construction, with bronze glands, bushings, stems, stem nuts, valve seats, and nozzles.
- B. Hydrants shall conform to the requirements of AWWA/ANSI C502 - Dry Barrel Fire Hydrants.
 1. Hydrant rated working pressure shall be 200 psig.
- C. Hydrant features shall conform to the following requirements:
 1. Main valve opening shall be a minimum of 5-1/4".
 2. Pumper and hose nozzles shall be threaded in accordance with National Standard hose coupling thread specifications..
 - a. Provide one (1) pumper nozzle, 4-1/2" nom. ID., 7.5 threads per inch.
 - b. Provide two (2) hose nozzles, 2-1/2" nom. ID., 6 threads per inch.
 3. Operating nut shall be National Standard, 1-1/2" pentagon, opening counter-clockwise.

4. Hydrants shall be warranted for ten (10) years against defects in materials and workmanship and shall be similar and equivalent to those produced by the following manufacturers:
 - a. Mueller Centurion Series
 - b. Clow Medallion Series
- D. Hydrant appearance and paint scheme shall be in accordance with the requirements of the local jurisdiction.

2.07 SERVICE SADDLES

- A. Shall consist of a brass body and two flattened silicone bronze straps, meeting applicable sections of ANSI/AWWA C800 - Underground Service Line Valves and Fittings.
- B. Outlet shall be tapped with AWWA I.P. thread (F.I.P.T.). Outlet shall be o-ring sealed.
- C. Shall be rated for a maximum working pressure of 200 psi.

2.08 REPAIR CLAMPS

- A. Clamps shall provide a gasketed seal around the full circumference of the pipe. Bolts shall be high strength stainless steel.
- B. Gasket dimensions shall suit existing and new pipe, as required.
- C. Quality standard: Mueller series 520 and 530.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that Work covered under other sections of these specifications is complete to the point that Work covered under this section may properly commence without hindering or damaging Work of other trades. Do not proceed with construction until unsatisfactory conditions have been corrected.
- B. Carefully examine all pipe fittings, valves and other appurtenances for damage and other defects immediately before installation.
- C. Mark and hold defective materials for inspection by Owner, who may prescribe corrective repairs or reject the materials.

- D. Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure-resisting bolts, cleanliness of valve ports and seating surfaces, handling damage and cracks. Hold defective valves for inspection by Owner.
- E. Verify installation or connection requirements prior to construction by potholing as necessary.

3.02 METHODS AND PROCEDURES

A. General

1. Prior to pipe installation, prepare trench in accordance with the plans and Section 02220 - Excavation, Backfilling and Compaction.
2. Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the Work. All pipe, fittings, and valves shall be lowered carefully into the trench by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to materials, protective coatings and linings. Under no circumstances shall water system materials be dropped or dumped into the trench.
3. Manufacturers' Installation Manual recommendations for handling and laying pipe, fittings and related materials shall be strictly adhered to. In no case shall these materials be dropped or dumped during transport, unloading, or handling.

3.03 INSTALLATION

A. Water Pipe Installation

1. Water pipe installation shall be in accordance with the applicable requirements of the following documents:
 - a. AWWA/ANSI C600 - Installation of Ductile Iron Water Mains and their Appurtenances.
 - b. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
 - c. DIPRA - The Guide for the Installation of Ductile Iron Pipe
 - d. UNI-B-3-92 - Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch).
2. All lumps, blisters, and excess coating shall be removed from the bell and spigot ends of each pipe, and the outside of the spigot and the inside of the bell shall be wiped clean and dry so as to be free from dirt, sand, grit, or any foreign material before the pipe is laid. Bevel and file spigot of pipe to prevent gasket damage during joint assembly.

3. The water pipe shall be laid and maintained to lines and grades established by the Drawings and Specifications with fittings and valves at the required locations unless otherwise approved by Owner.
4. When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the approval of Engineer to provide clearance as required by federal, state, or local regulations or as deemed necessary by Engineer to prevent future damage or contamination of either structure.
5. Lay all water lines on a continuous grade to avoid high points except as shown on the Drawings.
6. Prevent foreign material from entering the pipe while it is being placed in the trench. During laying operations, no soil, debris, tools, clothing, or other materials shall be placed in, or allowed to enter the pipe.
7. Assemble joints in accordance with manufacturer's recommendations.
8. The pipe shall be brought to correct line and grade, and shall be secured in place with approved backfill material in accordance with Section 02220 -Excavation, Backfilling and Compaction.
9. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long-radius curves are permitted, the amount of deflection allowed shall not exceed that recommended by pipe manufacturer.
10. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Owner. When practical, the plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water.
11. Where necessary, cut pipe perpendicular to the pipe centerline. Grind cut ends and rough edges smooth. For push-on joint connections, the cut end shall be beveled.
12. Fire hydrants shall be set plumb at proper finish grade as indicated on the drawings (see typical hydrant detail).

B. Valve Installation

1. Locate valves as shown on drawings.
2. Orient valve-operating stems in a manner that will allow proper operation.
3. A valve box shall be provided for every valve that has no gearing or operating mechanism or in which the gearing or operating mechanism is fully protected with a gear case. The valve box shall not transmit shock or stress to the valve and shall be centered over the operating nut of the valve. Set box cover at grade shown on Drawings.

4. In no case shall valves be used to bring misaligned pipe into alignment during installation. Support pipe in such a manner as to prevent stress on the valve.

C. Thrust Block Installation

1. Provide thrust blocks at reducers, valves, tees, hydrants, plugs and caps, and at bends deflecting 11-1/4 degrees or more.
2. Place thrust block between solid ground and the component to be shored; the area of bearing on the pipe and on the ground in each instance shall be that shown on Drawings. Unless otherwise shown or directed, locate block so as to contain the resultant thrust force and so that the pipe and fitting joints will be accessible for repair.
3. Concrete for thrust blocks shall have a compressive strength of not less than 2500 psi at 28 days. Concrete mixes shall be provided in accordance with Section 03300 of these specifications.

D. Corrosion Protection

1. Polyethylene encasement, if required shall be provided and installed in accordance with the requirements of AWWA/ANSI C105/A21.5 - Standard for Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.

3.04 PROTECTION

- A. Provide barricades and restrict access as appropriate to prevent damage to Work in place.
- B. Contractor shall be responsible for protection of Work in place against displacement, damage, loss, or theft until Owner's acceptance. Any Work installed and subsequently damaged, lost, or displaced shall be repaired or replaced to the Owner's satisfaction at no additional cost.

3.05 CLEANING

- A. Thoroughly clean all pipe lengths or units of all debris immediately after laying.
- B. Thoroughly clean by flushing and remove all debris from water mains and appurtenances. Inspect and verify lines are clean prior to submitting facilities for Owner's acceptance.

3.06 TESTING

- A. Temporary connections for pressure testing shall be made by Contractor at his expense and removed by Contractor after satisfactory completion of the testing Work.
- B. Hydrostatic Pressure Test:
 1. After completion of the installation of the system, or any reasonable length thereof, prior

to backfilling and after thorough flushing of the portion to be tested, pressure tests shall be made. The system to be tested shall be subjected to a hydrostatic pressure of 150 pounds per square inch, unless otherwise noted on the Drawings, for a period of not less than 2 hours duration.

2. The portion to be tested shall be filled with water slowly and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The Contractor shall make the temporary connection for pressure testing.
3. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation stops at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged by the Contractor.
4. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the Engineer.

C. Leakage Test:

1. A leakage test shall be conducted concurrently with the pressure test.
2. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
3. Maximum leakage during the pressure test shall not exceed the following value "L": L = Allowable leakage in gallons per hour

$$\text{Where: } L = \frac{S \times D \times \text{square root } P}{133,200}$$

S = Length (ft)

D = Diameter (in)

P = Pressure (psi)

Example: for a 4000' length of 16" pipe, tested at 150 psi for two hours, the maximum allowable leakage is calculated to be:

$$L = 11.8 \text{ gallons in 2 hours.}$$

4. Acceptance of installation shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified above, the Contractor shall, at his own expense, locate and repair the defective material until the leakage is within the specified allowance.
5. All visible leaks, other than a minor amount of sweating, shall require immediate

stoppage of the test and tightening of the joints so that, when pressure is again put on the system, there will be no leakage.

END OF SECTION

SECTION 331300 - DISINFECTION OF WATER DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Contractor shall provide all materials, labor, equipment, transportation and other items required to perform disinfection of water distribution systems as required by applicable codes and regulations, and as specified herein.
- B. Disinfection shall include but not be limited to the following:
 - 1. Flushing of water distribution system and supply lines
 - 2. Chlorine disinfection
 - 3. Final flushing

1.02 RELATED WORK

- A. Section 331100 - Potable Water Distribution Systems
 - 1. Construction and installation of water distribution piping, hydrostatic testing, cleaning and flushing requirements.

1.03 REFERENCES

- A. The applicable provisions of the latest editions of the References listed below shall govern the Work covered under this Section, unless there is a conflict between said References and the requirements of this Section. In the case of such a conflict, the requirements of this Section shall apply.
- B. American Water Works Association (AWWA)
- C. "Standard Methods for the Examination of Water and Wastewater", American Public Health Association, AWWA, and Water Pollution Control Federation
- D. Rules governing public drinking water systems as found in R309 of the Utah Administrative Code.

1.04 SUBMITTALS

- A. Submit manufacturer's literature, certifications, and other product data in accordance with Section 01300 - Submittals.
- B. Submittals required prior to testing include but are not limited to the following:

1. Evidence of materials conformance with these specifications
 2. Proposed methods and equipment to be used for disinfection.
- C. Submittals required after testing as a condition for final acceptance include but are not limited to the following:
1. Results of chlorine residual tests.
 2. Results of bacteriologic quality tests.

1.05 QUALITY ASSURANCE

- A. All disinfection and testing procedures shall be in accordance with applicable Federal, State, and local standards.

1.06 DELIVERY AND HANDLING

- A. Contractor shall be responsible for proper transportation, unloading, handling, storage and security of all equipment and materials provided as part of this specification in accordance with manufacturer's recommendations.
- B. Materials shall be stored in such a manner as to prevent damage or degradation. Any materials damaged or degraded prior to installation shall be removed from the project and replaced with new materials at no additional cost. Lost or stolen materials shall be replaced at no additional cost.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers providing materials as part of this specification shall have a minimum of five (5) years experience in the manufacture and testing of such materials.
- B. Manufacturers shall provide, upon request, verification of a consistent record of meeting or exceeding materials or performance standards as specified herein.

2.02 CHLORINE

- A. Tablets shall conform to AWWA B300 - Standard for Hypochlorites.
- B. Liquid shall conform to AWWA B301 - Standard for Liquid Chlorine.
- C. Store in a cool, dark, and dry environment to minimize deterioration.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine water facilities to verify they have been properly cleaned, flushed, and hydrostatically tested, as appropriate prior to performing disinfection Work. Verify that other Work will not contaminate or disturb disinfected facilities.
- B. Notify Engineer and Owner at least 72 hours prior to any flushing and disinfecting.

3.02 METHODS AND PROCEDURES

A. General

- 1. Disinfection procedures shall as a minimum be in accordance with the following specifications and regulations.
 - a. AWWA C651 - Disinfecting Water Mains
 - b. AWWA C652 - Disinfection of Water Storage Facilities

B. Preliminary Flushing of Water Distribution and Supply System

- 1. The flushing velocity shall not be less than 2.5 feet per second.
- 2. Water discharged from the flushing operation shall be conducted to approved natural drainage channels, storm sewers, or other locations in accordance with applicable laws, ordinances and regulations.
- 3. No flushing water shall be discharged into a sanitary sewer.

C. Chlorination of Water Distribution and Supply System

- 1. A 1 percent chlorine solution shall be prepared.
- 2. The chlorine solution shall be applied to the water line with a gasoline or electrically-powered chemical feed pump designed for feeding chlorine solutions. Feed lines shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.
- 3. Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipeline. The water shall receive a dose of the chlorine solution, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 mg/l available chlorine.

4. The ratio of application of the hypochlorite solution to water to maintain a 50 mg/l (50 ppm) chlorine concentration is as follows:
 - a. Application Ratio: 1 gal. of 1 percent chlorine solution to 200 gal water.
5. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water.
6. Chlorine application shall not cease until the entire line is filled with the chlorine solution.
7. The chlorinated water shall be retained in the line for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water shall contain no less than 25 mg/l chlorine throughout the length of the main.

D. Final Flushing of Water Distribution and Supply System

1. After the applicable retention period, the chlorinated disinfection water shall be flushed from the line.
2. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the line. The line shall be flushed until the residual chlorine concentration is less than 1 mg/l.
3. The discharge of highly chlorinated disinfection water to the environment is not allowed. The Contractor shall follow methods for de-chlorinating the disinfection water as found in AWWA C651.

E. Bacteriological Sampling and Testing

1. Sampling and testing shall be conducted in accordance with AWWA Manual M12 - Simplified Procedures for Water Examination.
2. Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulfate. No hose or fire hydrant shall be used in collection of samples. A sampling tap shall be as shown on the drawings.
3. After final flushing, and before the water line is placed in service, a sample shall be collected from the water line at 1000 foot intervals, evenly spaced along the line, and tested for coliform organisms in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater". The testing shall be by either the multiple tube fermentation technique or the membrane filter technique. Two samples shall be taken, from each location, at least 24 hours apart.
4. All samples shall be taken from a sampling tap.

5. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained.
6. When the samples are satisfactory, the water line may be placed in service upon receiving notification from the Construction Manager to do so.

3.03 INSTALLATION

Not Applicable

3.04 PROTECTION

- A. Contractor shall be responsible for maintaining disinfected facilities from contamination until acceptance by the Owner. Should facilities be contaminated prior to acceptance, Contractor shall re-disinfect and retest in accordance with 3.02 of these specification at no additional cost.

3.05 CLEANING

- A. Refer to 3.02 of these specifications

3.06 TESTING

- A. Refer to 3.02 of these specifications

END OF SECTION

SECTION 333100 - SANITARY SEWER SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Contractor shall provide all materials, labor, equipment, transportation and other items required to furnish and install sanitary sewer systems as indicated on the drawings, as required by applicable codes and regulations, and as specified herein.
- B. Sanitary sewer systems shall include but not be limited to the following:
 - 1. Sewer piping, manholes, and service laterals.
 - 2. Connections with existing sewerage facilities.
 - 3. Cleaning, flushing, and testing sewerage facilities.

1.02 RELATED WORK

- A. Section 312300 - Excavation, Backfill, and Compaction
 - 1. Trench excavation, over excavation of unsuitable materials, backfill placement and compaction associated with installation of items specified as part of this Work.
- B. Section 321500 - Restoration of Existing Improvements
 - 1. Repairs and restoration of existing underground, surface or above ground improvements disturbed or damaged as part of this Work.
- C. Section 033000 - Cast-In-Place-Concrete
 - 1. Construction of concrete structures associated with or required as part of this Work.

1.03 REFERENCES

- A. The applicable provisions of the latest editions of the References listed below shall govern the Work covered under this Section, unless there is a conflict between said References and the requirements of this Section. In the case of such a conflict, the requirements of this Section shall apply.
- B. American Society for Testing and Materials (ASTM)
- C. American National Standards Institute (ANSI)

- D. Uni-Bell PVC Pipe Association - Handbook of PVC Pipe
- E. Ductile Iron Pipe Research Institute (DIPRA)
- F. American Association of Safety and Highway Transportation Officials (AASHTO)
- G. Utah Department of Transportation Construction Standards (UDOT)

1.04 SUBMITTALS

- A. Submit shop drawings, manufacturer's literature, certifications, and other product data in accordance with Section 013000 – Submittal Procedures.
- B. Submittal data shall include, but not necessarily be limited to the following:
 - 1. Manufacturer's recommended transportation, unloading and storage requirements. Manufacturer's installation guides and instructions.
 - 2. Evidence of conformance with the requirements of these specifications.
 - 3. Dimensional information for structures, castings, and fittings.
- C. Contractor shall maintain accurate construction record drawings of all as-built invert elevations, manhole locations, pipe lengths, and wye locations and shall submit these records to the Engineer for approval prior to application for final completion.

1.05 QUALITY ASSURANCE

- A. Transportation, handling, storage and installation practices shall be in accordance with manufacturer's recommended practice for materials provided as part of this Work.
- B. Contractor's personnel shall be experienced in the installation of materials provided as part of the Work, and shall comply with manufacturer's recommended practices during handling, placement and installation of such materials.

1.06 DELIVERY AND HANDLING

- A. Contractor shall be responsible proper transportation, unloading, handling, storage and security of all equipment and materials to be provided as part of this specification in accordance with manufacturer's recommendations.
- B. Materials shall be stored in such a manner as to prevent damage or degradation. Any materials damaged prior to installation shall be removed from the project and replaced with new materials at no additional cost. Lost or stolen materials shall be replaced at no additional cost.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers providing materials or equipment as part of this specification shall have a minimum of five (5) years experience in the manufacture, testing, and installation of such materials and equipment.
- B. Manufacturers shall provide, upon request, verification of a consistent record of meeting or exceeding materials or performance standards as specified herein.
- C. Allowable Manufacturers - Subject to compliance with specified requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:
 - 1. Sanitary Sewer Piping
 - a. Polyvinyl Chloride (PVC)
 - i. J - M Manufacturing Company, Livingston, New Jersey
 - ii. Extrusion Technologies, Incorporated, Denver, Colorado
 - iii. Pacific Western Extruded Plastics Company, Eugene, Oregon
 - 2. Sanitary Sewer Manholes (Precast)
 - a. W. R. White Company, Ogden, Utah
 - b. Amcor Precast, Ogden, Utah
 - c. Geneva Pipe, Orem, Utah
 - 3. Sewer Lateral Stubs
 - a. Pipe and fittings shall be of same manufacturer as main piping.
 - b. Adaptors shall be Fernco or Romac.

2.02 SANITARY SEWER PIPING

- A. Sanitary sewer piping shall be of the size, type, and class specified on the drawings and as specified herein.
- B. Polyvinyl Chloride (PVC) Pipe
 - 1. Unless otherwise indicated, PVC pipe shall be SDR 35 designed and manufactured in accordance with ASTM D-3034 for pipes sizes 4" to 15" and ASTM F-679 for pipe sizes 18" to 27".

2. Pipe shall be bell and spigot type consisting of integral bell section, factory beveled spigot ends, and securely attached rubber sealing ring conforming to the requirements of ASTM D-3212.
3. Piping shall be green pigmented.
4. Fittings shall conform to the requirements of ASTM D-3034 (4" to 15") and shall be provided with joints conforming to ASTM D-3212.

2.03 SANITARY SEWER MANHOLES

- A. Manholes shall be either cast in place or precast units of the size, depth and configuration indicated on the drawings.
- B. Precast concrete manhole sections shall be designed and manufactured in accordance with the requirements of ASTM C-478.
- C. Manhole rings and flat top sections shall be designed and manufactured in accordance with the requirements of ASTM C-478 and AASHTO HS-20 loading.
- D. Manholes shall be of watertight construction, utilizing either bitumastic sealant or rubber gasket between adjacent manhole sections.
- E. Cement for manholes shall be Portland Cement, Type V, or Type II-A complying with ASTM C-150.
- F. All required openings in manhole sections shall be preformed during the casting process at proper locations required for indicated installation. Each opening shall be provided with a watertight rubber boot equipped with stainless steel bands to secure boot to both manhole and pipe connection.
- G. Manhole ring and cover shall be manufactured of grey iron castings conforming to ASTM A-48, Class 30, with non-rocking, machined bearing surfaces between cover and frame.
 1. Cover shall be non vented and shall bear the lettering "SEWER".
 2. Ring and cover shall weigh not less than 350 pounds.
- H. Manhole steps, if required, shall be cast in place units consisting of steel rebar construction covered with polyvinyl material and specifically manufactured for use in manhole installation.

2.04 SEWER LATERAL STUBS

- A. Sewer laterals, unless otherwise noted, shall consist of service wye, lateral pipe, plug, and cleanout as indicated on the drawings.

- B. Service wye shall comply with the requirements of local jurisdiction.
- C. Service laterals shall consist of 45 degree wye, bends, tees and other fittings conforming to ASTM D-3034 and D-3212, and PVC lateral piping conforming to ASTM D-3034.
- D. Provide approved 'Fernco' or other fittings for connections to existing services where required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify installation or connection requirements prior to construction by potholing as necessary.
- B. Verify that Work covered under other sections of these specifications is complete to the point that Work covered under this section may properly commence without hindering or damaging Work of other trades. Do not proceed with construction until unsatisfactory conditions have been corrected.

3.02 METHODS AND PROCEDURES

- A. Install materials and equipment included in the Work in accordance with materials/equipment manufacturer's recommended methods and procedures.

3.03 INSTALLATION

- A. General
 - 1. Install sewer piping to the lines, grades, and elevations indicated on the drawings. Install service wyes at the locations indicate or as otherwise required to provide service connections to existing services.
- B. Bedding:
 - 1. Bedding shall be prepared in accordance with Section 312300 of these specifications and as indicated on the drawings.
 - 2. Overexcavate as necessary and install approved material to provide firm, stable foundation for sewer piping installation. Overexcavation shall be approved by Engineer.
 - 3. Prepare bedding to insure trench bottom is free of large stones, debris, frozen, organic or other deleterious materials.
 - 4. Excavate to pipe bells to insure pipe is supported properly along its entire length.

C. Pipe Laying Procedures

1. Dewater trench as necessary to prevent the accumulation of groundwater or other unacceptable water in trench.
2. Pipe laying operations shall proceed in an uphill direction with all bell facing uphill unless otherwise specifically approved by Engineer.
3. Contractor shall follow pipe manufacturer's recommended practice for lowering, assembling, and installing sewer pipe.
4. During pipe installation, verify that no foreign material is inside pipe. Clean interior of each pipe joint prior to installation.
5. Sewer pipe shall be laid to uniform line and grade between manholes unless otherwise approved by the Engineer.
6. Plug open end of installed sewer piping and close trench at the end of each day's work. Open trenches may not be left overnight without specific permission from the Engineer.

D. Water main crossing requirements:

1. Maintain 18" vertical separation wherever possible.
2. Sewer mains shall be installed beneath water mains wherever possible.
3. If vertical separation or installation beneath water main requirement can not be met, provide ductile iron sewer piping for a distance of not less than 10 feet on either side of the crossing. Pipe joints shall be located to provide maximum distance from water mains. Advise Engineer of vertical separation less than 18" and receive approval of corrective measures prior to proceeding with sewer main installation.
4. If 12" vertical separation can not be provided, encase sewer main in concrete for a distance of not less than 10 feet on either side of crossing.

E. Horizontal separation requirements.

1. Maintain a minimum 10' horizontal separation between sewer main and existing water mains wherever possible.
2. Provide ductile iron sewer piping for sections where 10' horizontal separation is not possible. Advise Engineer of horizontal separation less than 10' and receive approval of corrective measures prior to proceeding with sewer main installation.

F. Backfilling

1. Install backfill and compact in accordance with manufacturer's requirements and as indicated on the drawings. Backfill shall not be placed in lifts greater than can be properly compacted to the required density.
2. Backfill material shall be free of large rocks, organic or frozen material.

G. Manholes

1. Excavation, bedding and backfill for manhole installation shall be in accordance with Section 312300 of these specifications and as indicated on the drawings.
2. Install manholes at locations and to grades indicated on the drawings.
3. Set manhole lid flush with finished surface unless otherwise noted on the drawings.
4. Cast-in-place base and floor shall conform with requirements of standard details for layout and configuration.
5. All lifting holes shall be grouted watertight.
6. Prevent debris from entering installed sewer main piping via manholes by providing suitable barriers or covers.
7. Pipe transition into manhole must be smooth and free of any pockets or indentations. Any such inconsistencies shall be filled with non-shrink grout to form a smooth surface.

3.04 PROTECTION

- A. Provide barricades and restrict access as appropriate to prevent damage to Work in place.
- B. Contractor shall be responsible for protection of Work in place against displacement, damage, loss or theft until Owner's acceptance. Any Work installed and subsequently damaged, lost, or displaced shall be repaired or replaced to the Owner's satisfaction at no additional cost.

3.05 CLEANING

- A. Thoroughly clean all pipe lengths or units of all debris immediately after laying.
- B. Thoroughly clean by flushing and remove all debris from sewer mains and manholes. Inspect and clean all lines as specified herein. Sewerage facilities shall be thoroughly cleaned prior to turning over to the Owner.

3.06 TESTING

- A. Contractor shall provide all materials, equipment, and labor to perform testing of installed sewer main piping, services, and manholes as required for acceptance by Engineer.
- B. Engineer shall be notified no less than two full working days prior to any proposed testing.
- C. The sewer main shall be tested after placement of pipe zone material but before final backfill and surfacing.
- D. Testing of sewer mains shall consist of the following.
 - 1. Engineer, Owner or their representative shall visually inspect each run of piping by lamping to verify consistent line and grade.
 - 2. Mandrel testing
 - a. Mandrel (deflection testing) shall be conducted no sooner than 30 days after pipe is backfilled.
 - b. Mandrel shall be manufactured to provide proofing ring and minimum 9-point bearing with an outside diameter of 95% of the average inside diameter of line to be tested. Contractor shall provide certifications that mandrel meets these requirements prior to testing.
 - c. Mandrel shall be pulled by hand in the presence of the Engineer and shall pass freely through the line being tested.
 - d. In the event the mandrel cannot pass freely through the line, pipe shall be excavated, rebedded and backfilled to reduce pipe deflection below 5%. All costs for excavation, rebedding, and repair of deflected pipe shall be borne by Contractor.
 - e. Contractor shall reperform mandrel test and make repairs until acceptable deflection results.
 - 3. Low pressure air testing.
 - a. Plug each end of pipe to be tested with suitable test plugs and brace each plug securely. Plugs shall be equipped with pressure release devices set to a maximum of 6 psi.
 - b. Locate all gauges, manifolds and valves on outside of manhole. No personnel shall be allowed to enter manhole during testing procedure.
 - c. Slowly increase pressure in line to be tested to 4.0 psi above external hydrostatic pressure on piping.

- d. Allow internal pressure to stabilize for two (2) minutes, adding air as necessary to maintain 4.0 psi.
 - e. Disconnect air supply and allow line pressure to drop to 3.5 psi, where upon test interval is started.
 - f. Determine time interval from beginning of test until line pressure drops to 2.5 psi.
 - g. Refer to allowable time interval table included in this section of these specifications for the line size tested. If time interval exceeds minimum allowable time, line segment shall be considered as passing low pressure air test.
- E. In the event that line fails testing, Contractor shall make all required repairs, replacements, or other measures necessary to pass required acceptance tests. All costs for repair, replacement, and retesting to verify acceptability of installed work shall be borne by the Contractor at no additional cost to the Owner.
- F. If the above minimum specifications cannot be met after all sources of air leakage have been corrected, a water exfiltration test may be conducted with Engineer's approval to determine the acceptability of the test section.
- 1. Exfiltration Tests: The length of pipe tested shall be limited so that the pressure on the invert of the lower end of the section tested shall not exceed 16 feet of water column, and in no case shall the length of the section tested be greater than 400 feet or the distance between manholes, whichever is less.
 - 2. Allowable Leakage: The measured rate of leakage during the test shall not exceed 200 gallons per inch of pipe diameter per mile of pipe per 24 hours, with a 6-foot head at the crown at the upper end of the test section.

TIME HOLDING CHART

Time in Seconds Required For Pressure Drop From 3.5 to 2.5 psig
Dry Pipe Test Standard (Based on 0.005 cfm/sf and 2.0 cfm)

<u>Len</u>	<u>Pipe Diameter in Inches</u>												
	<u>4"</u>	<u>6"</u>	<u>8"</u>	<u>10"</u>	<u>12"</u>	<u>15"</u>	<u>18"</u>	<u>21"</u>	<u>24"</u>	<u>27"</u>	<u>30"</u>	<u>33"</u>	<u>36"</u>
25	3	6	10	16	23	36	51	73	95	120	149	179	214
50	5	1	20	32	46	71	102	146	190	241	297	359	428
75	8	17	30	47	69	106	153	218	285	361	446	539	612
100	10	23	41	64	91	142	204	291	383	459	511	561	
125	13	29	51	79	114	177	255	357	408				

150	15	34	61	95	137	212	306										
175	18	40	71	111	160	255											
200	20	46	81	127	188												
225	23	51	91	143	204												
250	25	57	102	159													
275	28	63	112	174													
300	31	69	122														
350	36	81	142														
450	46	103															
500	51																
550	56																
600	61	103	142	174	204	255	306	357	408	459	511	561	612				

SANITARY SEWER SYSTEMS

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Utah National Guard - NSL Readiness Center

TIME HOLDING CHART

Time in Seconds Required For Pressure Drop From 3.5 to 2.5 psig
Wet Pipe Test Standard (Based on 0.003 cfm per sq. ft. and 2.0 cfm)

<u>Len</u>	<u>Pipe Diameter in Inches</u>												
	<u>4"</u>	<u>6"</u>	<u>8"</u>	<u>10"</u>	<u>12"</u>	<u>15"</u>	<u>18"</u>	<u>21"</u>	<u>24"</u>	<u>27"</u>	<u>30"</u>	<u>33"</u>	<u>36"</u>
25	4	10	18	28	40	62	89	121	158	200	248	299	356
50	9	20	35	55	79	124	178	243	317	401	495	599	713
75	13	30	53	83	119	186	267	364	475	601	743	898	1020
100	18	40	71	110	158	248	356	485	639	765	851	935	
125	22	50	88	138	198	309	446	595	680				
150	26	59	106	165	238	371	510						
175	31	69	123	193	277	425							
200	35	79	141	220	317								
225	40	89	158	248	340								
250	44	99	176	275									
275	48	109	194	283									
300	53	119	211										
350	62	139	227										
400	70	158											
450	79	170											
500	88												
550	97												
600	106												
650	113	170	227	283	340	425	510	595	680	765	851	935	1020

END OF SECTION

SECTION 334100 - STORM SEWAGE SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Storm sewage piping
- B. Inlet boxes and cleanout boxes with grates and lids as required.

1.02 RELATED WORK

- A. Section 013000 - Submittals: For manufacturer's specifications for all products.
- B. Section 312300 - Trenching, Backfilling and Compacting
- C. Section 033000 - Cast-In-Place-Concrete

1.03 QUALITY ASSURANCE

- A. Workmanship and methods employed in the handling, transportation, storage, bedding, and laying of pipe, fittings, associated structures and accessories shall conform to the appropriate manufacturers' recommendations and/or ASTM recommendations.
- B. All products shall be inspected by Contractor, prior to installation, for damage. No damaged products will be used.

1.04 REFERENCES

- A. "Manual of Standard Practices", Concrete Reinforcing Steel Institute (CRSI)
- B. American Society for Testing and Materials (ASTM):
 - 1. A-615, "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"

1.05 SUBMITTALS

- A. Submit manufacturer's specifications for all products.

1.06 DELIVERY AND HANDLING

- A. Load and unload pipe, fittings, and accessories in such a manner as to avoid shock or damage.

PART 2 PRODUCTS

2.01 STORM SEWAGE PIPING

A. CONCRETE PIPE

1. For 12" diameter and larger:
 - a. RCP (reinforced concrete pipe) shall meet the requirements of ASTM C-76, Class III, with push-on gasket joints conforming to ASTM C-443. Cement for the pipe shall be Portland Cement Type V, conforming to ASTM C-150.
2. For diameters smaller than 12":
 - a. Concrete pipe shall meet the requirements of ASTM C-14, Class III, with push-on gasket joints conforming to ASTM C-443. Cement for the pipe shall be Portland Cement, Type V, complying to ASTM C-150.

B. PVC PIPE

1. For diameters smaller than 15"
 - a. PVC (polyvinyl chloride) shall meet the requirements of ASTM D3034 for SDR 35. The pipe shall have integral wall bell and spigot joints conforming to ASTM D-3212, with a solid crosssection rubber ring, factory assembled, securely locked in place to prevent displacement during assembly.

C. HDPE PIPE

1. For 12" diameter and larger:
 - a. AASHTO M294 Type S with smooth waterway for coupling joints. Fittings shall be bell and spigot full ASTM B3212 and ASTM F477 joints (elastomeric gasket).
2. For smaller than 12" diameter:
 - a. AASHTO M252 Type S with smooth waterway for coupling joints. Fittings shall be bell and spigot full ASTM B3212 and ASTM F477 joints (elastomeric gasket).

2.02 INLET AND CLEANOUT BOX MATERIALS

- A. Concrete, forms and reinforcement: Shall be as specified in Section 033000.
- B. Rings, Lids and Grates shall be as specified on the Drawings.

PART 3 EXECUTION

3.01 PREPARATION

- A. When connections are to be made to any existing pipe, conduit, or other improvement, the actual elevation or position of which cannot be determined without excavation, the Contractor shall excavate for and expose the existing improvement before laying any pipe or conduit.

3.02 PIPE INSTALLATION

- A. Bedding:
 - 1. Bedding shall be prepared in accordance with Section 312300 - TRENCHING, BACKFILLING AND COMPACTING and as shown on the Drawings.
 - 2. Lay all pipes on a firm bed, true to the line and grade, and abutt the end and shoulder of each pipe against the other in such a manner that there is no unevenness of any kind along the bottom half of the pipe line.
- B. During all phases of pipe installation, dewater trench to prevent floating of pipe.
- C. Lay pipe in the uphill direction with the bell end pointing upgrade.
- D. Clean pipe joints prior to installing gaskets. Install gaskets in accordance with manufacturers' recommendations.
- E. Manufacturers' Recommendations: Perform all work in strict accordance with the manufacturer's recommendations for the type of pipe being installed.
- F. Prevent contact between the pipe and compaction equipment. Compaction of bedding and backfill material should generally be done in such a way so that compaction equipment is not used directly above the pipe until sufficient backfill has been placed to assure that such compaction equipment will not have a damaging effect on the pipe.

3.03 INLET AND CLEANOUT BOXES

- A. Formwork, Reinforcement and Cast-in-place Concrete: Shall be as specified in Section 033000.

3.04 CLEANING AND FLUSHING OF STORM SEWAGE PIPING

- A. Thoroughly clean all pipe lengths or units laid of all debris immediately after laying.
- B. Thoroughly clean by flushing and remove all debris from the pipeline and drainage structures prior to acceptance of the work by the Construction Manager.

3.06 PROTECTION

- A. Protect all newly poured concrete from damage by placing barricades or enclosures in accordance with Section 015000 – TEMPORARY FACILITIES AND CONTROLS.

END OF SECTION

SECTION 335113 - GAS DISTRIBUTION SYSTEM

PART 1 GENERAL

1.01 WORK INCLUDED:

- A. Gas line, including connections to existing system, line and fittings.
- B. Pressure testing

1.02 RELATED WORK:

- A. Section 312300 - Trenching, Backfilling and Compacting: For pipe bedding and backfill.
- B. Section 013000 - Submittals: For manufacturers' specifications and parts lists.

1.03 QUALITY ASSURANCE:

- A. Comply with federal, state and local codes and regulations.
- B. Installation shall be by an installer currently approved by Questar for installing PE piping for natural gas distribution service.
- C. Comply with applicable provisions of American Gas Association Plastic Pipe Manual for Gas Service and become thoroughly familiar with the requirements of the applicable ordinances or codes, the standards of the Uniform Mechanical Code, American Gas Association, the National Board of Fire Underwriters and the National Electrical Code.

1.04 REFERENCES:

- A. American Society for Test and Materials (ASTM):
 - 1. D2513 - Thermoplastic Pressure Pipe, Tubing, and Fittings
 - 2. D3350 - Polyethylene Plastic Pipe and Fittings Material
 - 3. D1248 - Polyethylene Plastics Molding and Extrusion Materials
 - 4. D2638 - Socket-type Polyethylene Fittings for Outside-Diameter Controlled Polyethylene Pipe
 - 5. D2774 - Recommended Practice for Underground Installation of Thermoplastic Pressure Piping

1.05 SUBMITTALS:

- A. Submit manufacturer's specifications for all materials in accordance with Section 01300 - Submittals.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

- A. Gas service laterals:
1. Polyethylene pressure pipe (PE), PE 2406, Type II medium density, conforming to ASTM D1248 and ASTM D3350.
 2. Size as noted on the drawings.
 3. PE pipe and fittings shall be installed within 24 months from date of manufacturer.

- B. Wall Thickness:

<u>Nominal Pipe Size</u>	<u>SRD</u>	<u>OD, in.</u>	<u>Min. Wall Thickness, in.</u>
1/2" CTS	7	.625	.090
3/4" IPS	11	1.050	.095
1" IPS	11	1.315	.119
2" IPS	11	2.375	.216
3" IPS	11.5	3.500	.307
4" IPS	11.5	4.500	.395

(Note: CTS = copper tubing size; IPS = iron pipe size.)

- C. Joints:
1. Fusion Welded socket-type joints.

2.02 TRACER WIRE AND MARKING TAPE:

- A. Tracer wire:
1. New, coated, continuous and unbroken #14 or heavier copper conductor, with solderless wrapped wire connectors.
- B. Marking tape:
1. Orange, polyethylene sheet, minimum 4 mils thick and 3" wide, Terra Tape or equal.

PART 3 EXECUTION

3.01 INSPECTION:

- A. All pipe, fittings and other appurtenances shall be examined carefully for damage and other defects immediately before installation.

- B. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.

3.02 PREPARATION:

- A. Furnish temporary support, adequate protection, and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work.
- B. The trench bottom pipe bedding surface shall be prepared in accordance with the plans and Section 312300 - TRENCHING, BACKFILLING AND COMPACTION prior to pipe installation.
- C. Load and unload pipe, fittings, and accessories so as to avoid shock or damage.
- D. Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the work. All pipe and fittings shall be lowered carefully into the trench in such a manner as to prevent damage to materials. All tools and equipment, handling and installation procedures shall conform to recommendations of the pipe and fittings manufacturer.

3.03 GAS PIPE INSTALLATION:

- A. The gas pipe shall be laid and maintained to lines and grades established by the plans and specifications. Maintain minimum vertical clearance of 12 inches and minimum horizontal clearance of 36 inches between gas piping and other piping unless otherwise directed by the Engineer.
- B. Service laterals shall be installed with 24 inch cover wherever possible, and in no case less than 18 inches.
- C. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.

3.04 TRACER WIRE INSTALLATION:

- A. Tracer wire shall be installed with all gas piping at 4" to 6" above the top of the pipe.
- B. Wire shall be terminated at service risers by extending above ground and wrapping around riser casing.
- C. Identify all dead ends with warning tape tied to end of piping and extending so that at least 1

foot of tape will remain exposed on the surface backfill is completed.

3.05 FIELD QUALITY CONTROL:

- A. Safety procedures, preparations for testing, pre-installation testing, and post-installation testing of the gas piping system shall conform to Questar Standard Practice: "Testing IHP and LP Pipelines".

END OF SECTION

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Remote annunciator.
 - 7. Addressable interface device.
 - 8. System printer.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only. The fire alarm system shall tie into the Mass Notification system and shall allow that the horns in the fire alarm system be disabled by the Mass Notification system to allow mass notification prerecorded messages to be heard. The system horns shall then be enabled by the Mass Notification system to sound. All operations shall comply with the requirements of UFC 04-021-01 - Mass Notification Systems.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.6 SUBMITTALS

- A. General Submittal Requirements:
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 - 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.

- b. NICET-certified fire-alarm technician, Level III minimum.
 - c. Licensed or certified by authorities having jurisdiction.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - 6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 - 7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
 - 2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.
- E. Qualification Data: For qualified Installer.
- F. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 5. Manufacturer's required maintenance related to system warranty requirements.
 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 7. Copy of NFPA 25.
- I. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.8 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 5. Keys and Tools: One extra set for access to locked and tamperproofed components.
 - 6. Audible and Visual Notification Appliances: One of each type installed.
 - 7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Edwards Systems Technology.
 - 2. Fire Control Instruments, Inc.; a Honeywell company.
 - 3. Fire Lite Alarms; a Honeywell company.
 - 4. GE Infrastructure; a unit of General Electric Company.
 - 5. NOTIFIER; a Honeywell company.
 - 6. Siemens Building Technologies, Inc.; Fire Safety Division.
 - 7. Silent Knight; a Honeywell company.
 - 8. SimplexGrinnell LP; a Tyco International company.
 - 9. Viking

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Duct smoke detectors.
 - 5. Verified automatic alarm operation of smoke detectors.
 - 6. Automatic sprinkler system water flow.
 - 7. Heat detectors in elevator shaft and pit.
 - 8. Fire-extinguishing system operation.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances.
 - 2. Identify alarm at fire-alarm control unit and remote annunciators.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths.
 - 5. Release fire and smoke doors held open by magnetic door holders.
 - 6. Activate voice/alarm communication system.

7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 9. Recall elevators to primary or alternate recall floors.
 10. Activate emergency shutoffs for gas and fuel supplies.
 11. Record events in the system memory.
 12. Record events by the system printer.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Elevator shunt-trip supervision.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
 9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 40 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

- C. Circuits:
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
 - a. Initiating Device Circuits: Style E.
 - b. Notification Appliance Circuits: Style Z.
 - c. Signaling Line Circuits: Style 7.
 - d. Install no more than 50 addressable devices on each signaling line circuit.
 2. Serial Interfaces: Two RS-232 ports for printers.
- D. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- E. Notification Appliance Circuit: Operation shall sound in a temporal pattern.
- F. Elevator Recall:
1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
 3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- I. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

- J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed lead calcium.
- L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Station Reset: Key- or wrench-operated switch.
 - 3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 - 4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be four-wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
 - 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.

- b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
 - 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
 - 4. Each sensor shall have multiple levels of detection sensitivity.
 - 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 - 6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 3. Detector Cable: Rated detection temperature 155 deg F (68 deg C). NRTL listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short-circuit wires at the location of elevated temperature.
 - 4. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
 - 5. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone

shall be individually reported to central fire-alarm control unit as separately identified zones.

6. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 2. Mounting: Wall mounted unless otherwise indicated.
 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 4. Flashing shall be in a temporal pattern, synchronized with other units.
 5. Strobe Leads: Factory connected to screw terminals.
 6. Mounting Faceplate: Factory finished, red.

2.8 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.9 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relays: Capable of providing a direct signal to elevator controller to initiate elevator recall and to initiate circuit-breaker shunt trip for power shutdown.

2.10 SYSTEM PRINTER

- A. Printer shall be listed and labeled by an NRTL as an integral part of fire-alarm system.

2.11 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by manufacturer of device.
 - 2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than **72 inches (1830 mm)** above the finished floor. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install seismic bracing. Comply with requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than **72 inches (1830 mm)** above the finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 - 2. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed **30 feet (9 m)**.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
 - 5. HVAC: Locate detectors not closer than **3 feet (1 m)** from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than **12 inches (300 mm)** from any part of a lighting fixture.

- E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- F. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- G. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- H. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- I. Audible Alarm-Indicating Devices: Install not less than **6 inches (150 mm)** below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least **6 inches (150 mm)** below the ceiling.
- K. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- L. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than **72 inches (1830 mm)** above the finished floor.
- M. Annunciator: Install with top of panel not more than **72 inches (1830 mm)** above the finished floor.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than **3 feet (1 m)** from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Alarm-initiating connection to elevator recall system and components.
 - 3. Supervisory connections at valve supervisory switches.
 - 4. Supervisory connections at elevator shunt trip breaker.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Training shall incorporate the Mass Notification System operation and interface operations. Minimum of 4 hours of training to be supplied to up to 20 people selected by Utah National Guard in a single classroom setting.

END OF SECTION 283111

SECTION 260943 - NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes manually operated lighting controls with relays and control module.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for time switches, photoelectric switches, occupancy sensors, and multipole contactors.

1.3 DEFINITIONS

- A. BACnet: A networking communication protocol that complies with ASHRAE 135.
- B. BAS: Building automation system.
- C. DALI: Digital addressable lighting interface.
- D. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.
- F. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- G. PC: Personal computer; sometimes plural as "PCs."
- H. Power Line Carrier: Use of radio-frequency energy to transmit information over transmission lines whose primary purpose is the transmission of power.
- I. RS-485: A serial network protocol, similar to RS-232, complying with TIA/EIA-485-A.

1.4 SUBMITTALS

- A. Product Data: For control modules, power distribution components, manual switches and plates, and conductors and cables.
- B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.
 - 1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
 - 2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
 - 3. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
- C. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
 - 1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
 - 2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.
- D. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
- E. Field quality-control test reports.
- F. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- G. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- D. Comply with protocol described in IEC 60929, Annex E, for DALI lighting control devices, wiring, and computer hardware and software.
- E. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
 - 1. Match components and interconnections for optimum performance of lighting control functions.
- B. Coordinate lighting control components specified in this Section with components specified in Division 26 Section "Panelboards."

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of software input/output to execute switching or dimming commands.
 - b. Failure of modular relays to operate under manual or software commands.
 - c. Damage of electronic components due to transient voltage surges.
 - 2. Warranty Period: Two years from date of Substantial Completion.
 - 3. Extended Warranty Period Failure Due to Transient Voltage Surges: Eight years.
 - 4. Extended Warranty Period for Electrically Held Relays: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Electrically Held Relays: Refer to the relay panel schedule.

1.9 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revise licenses for use of the software.
 - 1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Intelligent Lighting Controls, Inc.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lighting Control & Design, Inc.
 - 4. Lightolier Controls; a Genlyte Company.
 - 5. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 6. Lutron Electronics Company, Inc.
 - 7. MicroLite Lighting Control Systems.
 - 8. NexLight; Northport Engineering Group.
 - 9. Square D; Schneider Electric.
 - 10. PMC, Inc.
 - 11. Watt Stopper (The).

2.2 SYSTEM REQUIREMENTS

- A. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.
- B. Performance Requirements: Manual switch operation sends a signal to programmable-system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits to groups of lighting fixtures or other loads.
- C. BAS Interface: Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports.
 - 1. Hardwired Points:
 - a. Monitoring: On-off status,.

- b. Control: On-off operation,.
2. Required communication interface with the BAS shall enable the BAS operator to remotely control and monitor lighting from a BAS operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the BAS. Coordinate required communications interface with BAS protocol.

2.3 CONTROL MODULE

- A. Control Module Description: Comply with UL 916 (CSA C22.2, No. 205); microprocessor-based, solid-state, 365-day timing and control unit. Output circuits shall be switched on or off by internally programmed time signals or by program-controlled analog or digital signals from external sources. Output circuits shall be pilot-duty relays compatible with power switching devices. An integral keypad shall provide local programming and control capability. A key-locked cover and a programmed security access code shall protect keypad use. An integral alphanumeric LCD or LED shall display menu-assisted programming and control.
- B. Control Module Description: Comply with UL 916 (CSA C22.2, No. 205); microprocessor-based, solid-state, 365-day timing and control unit. Control units shall be programmable and capable of receiving inputs from indicated sensors and hand-held programmer. Output circuits shall be pilot-duty relays compatible with power switching devices. Output circuits shall include digital circuits arranged to transmit control commands to remote preset dimmers. Modules and their associated control panels shall include the following features:
 1. Multichannel output with required channels.
 2. Multiple inputs and multichannel output arranged for required channels.
 3. Multiple inputs for occupancy sensors, daylight sensors, and step dimming systems with associated daylight sensors.
- C. Control Module Description: Programmable, PC-based unit with 17-inch color video monitor and keyboard for graphic display and programming of system status and to override breaker status; and to display status of local override controls and diagnostic information. If the control module is applied to emergency lighting units, control unit shall indicate failure of normal power and that the lighting units are, or are not, powered by the alternate power source.
 1. Display: Separate graphic displays for programming each lighting control panelboard.
 2. Interoperability: Control module shall be configured to connect with other control systems using RS-485 network to enable remote workstations to use control module functions.
 3. Interoperability: Control module shall be configured to connect to BAS protocol compliant network, resulting in extending control to any network-compliant devices such as occupancy switches.
 4. Interoperability: Lighting control shall be configured to allow individual users to turn lighting on and off with their PCs. Software shall be written for Windows operating system, with Web page as the display and ActiveX controls that can be accessed through an Internet browser. Include at least three levels of password protection. Include an egress lighting option that will provide each user with a lighted path for exiting the building after normal working hours.
 5. System Memory: Nonvolatile. System shall reboot program and reset time automatically without errors after power outages up to 90 days' duration.

6. Software: Lighting control software shall be capable of linking switch inputs to relay outputs, retrieving links, viewing relay output status, controlling relay outputs, simulating switch inputs, setting device addresses, and assigning switch input and relay output modes.
7. Automatic Time Adjustment: System shall automatically adjust for leap year and daylight saving time and shall provide weekly routine and annual holiday scheduling.
8. Astronomic Control: Automatic adjustment of dawn and dusk switching.
9. Demand Control: Demand shall be monitored through pulses from a remote meter and shall be controlled by programmed switching of loads. System capability shall include sliding window averaging and programming of load priorities and characteristics. Minimum of two different time-of-day demand schedules shall execute load-management control actions by switching output circuits or by transmitting other types of load-control signals.
10. Confirmation: Each relay or contactor device operated by system shall have auxiliary contacts that provide a confirmation signal to the system of on or off status of device. On or off status confirmation for each electrically operated circuit breaker shall be provided by an auxiliary contact or by a sensing device at load terminal.
 - a. Software shall interpret status signals, provide for their display, and initiate failure signals.
 - b. Lamp or LED at control module or display panel shall identify status of each controlled circuit.
11. Remote Communication Capability: Allow programming, data-gathering interrogation, status display, and controlled command override from a PC at a remote location over telephone lines. System shall include modem, communications and control software, and remote computer compatibility verification for this purpose.
12. Telephone Override Capability: Override programmed lighting shutdown commands by telephoning computer and shall enter a voice-menu-guided, override touch-tone code specific to zone being controlled.
13. Local Override Capability: Manual, low-voltage control devices shall override programmed shutdown of lighting and shall override other programmed control for intervals that may be duration programmed.
14. Automatic Control of Local Override: Automatic control shall switch lighting off if lighting has been switched on by local override.
15. Automatic battery backup shall provide power to maintain program and system clock operation for 90 days' minimum duration when power is off.
16. Programmed time signals shall change preset scenes and dimmer settings.
17. Daylight Compensating Switch Control: Control module shall interpret a preset threshold illumination-level signal from a photoelectric relay and shall activate relays controlling power to selected groups of lighting fixtures to turn them on and off to maintain adjustable minimum illumination level as daylight contribution varies.
18. Energy Conservation: Bilevel control of multiple ballasts as indicated on the drawings.
19. Flick Warning: Programmable momentary turnoff of lights shall warn that programmed shutoff will occur after a preset interval. Warning shall be repeated after a second preset interval before end of programmed override period.
20. Diagnostics: When system operates improperly, software shall initiate factory-programmed diagnosis of failure and display messages identifying problem and possible causes.
21. Additional Programming: In addition to system programming by the PC, individual control modules shall be programmable using data-entry and -retrieval (such as PCs,

personal digital assistants (PDAs), hand-held infrared programming devices, wired Ethernet hubs, wireless IEEE 802.11 hubs).

2.4 POWER DISTRIBUTION COMPONENTS

- A. Modular Relay Panel: Comply with UL 508 (CSA C22.2, No. 14) and UL 916 (CSA C22.2, No. 205); factory assembled with modular single-pole relays, power supplies, and accessory components required for specified performance.
1. Cabinet: Steel with hinged, locking door.
 - a. Barriers separate low-voltage and line-voltage components.
 - b. Directory: Mounted on back of door. Identifies each relay as to load groups controlled and each programmed pilot device if any.
 - c. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.
 2. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type.
 - a. Low-Voltage Leads: Plug connector to the connector strip in cabinet and pilot light power where indicated.
 - b. Rated Capacity (Mounted in Relay Panel): 20 A, 125-V ac for tungsten filaments; 20 A, 277-V ac for ballasts.
 - c. Endurance: 50,000 cycles at rated capacity.
 - d. Mounting: Provision for easy removal and installation in relay cabinet.
- B. Electrically Operated, Molded-Case Circuit-Breaker Panelboard: Comply with NEMA PB 1 and UL 50 (CSA C22.2, No. 94), UL 67 (CSA C22.2, No. 29), UL 489 (CSA C22.2, No. 65), and UL 916 (CSA C22.2, No. 205).
1. Cabinets: In addition to requirements specified below, comply with Division 26 Section "Panelboards."
 2. Electrically Operated, Molded-Case Circuit Breakers: Bolt-on type.
 - a. Switching Endurance Ratings: Certified by manufacturer or by a nationally recognized testing laboratory (NRTL) for at least 20,000 open and close operations under rated load at 0.8 power factor.
 - b. Minimum 30,000 open and close operations with load equal to circuit-breaker trip rating and consisting of 100 percent tungsten filament load.
 - c. Minimum 30,000 open and close operations with load equal to circuit-breaker trip rating and consisting of 100 percent fluorescent ballasts rated for 10 percent total harmonic distortion.
 - d. Listed and labeled as complying with UL SWD, HCAR, and HID ratings by a national recognized testing laboratory (NRTL) acceptable to authorities having jurisdiction.
- C. Line-Voltage Surge Suppression: Factory installed as an integral part of 120- and 277-V ac, solid-state control panels.

- D. Line-Voltage Surge Suppression: Field-mounting surge suppressors that comply with Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for Category A locations.
- E. Line-Voltage Surge Suppression: Factory installed as an integral part of 120- and 277-V ac, solid-state control panels or field-mounting surge suppressors that comply with Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for Category A locations.

2.5 MANUAL SWITCHES AND PLATES

- A. Push-Button Switches: Modular, momentary-contact, low-voltage type.
 - 1. Match color specified in Division 26 Section "Wiring Devices."
 - 2. Integral green LED pilot light to indicate when circuit is on.
 - 3. Internal white LED locator light to illuminate when circuit is off.
- B. Manual, Maintained Contact, Full- or Low-Voltage Switch: Comply with Division 26 Section "Wiring Devices."
- C. Wall Plates: Single and multigang plates as specified in Division 26 Section "Wiring Devices."
- D. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Digital and Multiplexed Signal Cables: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 6 for horizontal copper cable and with Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Comply with NECA 1.

- B. Wiring Method: Install wiring in raceways. Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" Minimum conduit size shall be 1/2 inch (13 mm).
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- E. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.
- G. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Test for circuit continuity.
 - 2. Verify that the control module features are operational.
 - 3. Check operation of local override controls.
 - 4. Test system diagnostics by simulating improper operation of several components selected by Architect.

3.3 SOFTWARE INSTALLATION

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software training for PC-based control systems. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260943

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.

- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- K. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- L. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
 - 1. Common ground bonding with lightning protection system.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
 1. No. 4 AWG minimum, soft-drawn copper.
 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.
- D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 1. Pipe Connectors: Clamp type, sized for pipe.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If

necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 - 10. Communications Cable Tray
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than **60 feet (18 m)** apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than **24 inches (600 mm)** from building foundation.
- J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of **20 feet (6 m)** of bare copper conductor not smaller than No. 2/0 AWG.
 - 1. If concrete foundation is less than **20 feet (6 m)** long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Substations and Pad-Mounted Equipment: 5 ohms.
 5. Manhole Grounds: 10 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes aluminum cable trays and accessories.

1.3 SUBMITTALS

- A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
 - 2. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
 - a. Design Calculations: Calculate requirements for selecting seismic restraints.
 - b. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.
- C. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:
 - 1. Vertical and horizontal offsets and transitions.
 - 2. Clearances for access above and to side of cable trays.
 - 3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Aluminum cable tray may be stored outside without cover, but shall be loosely stacked, elevated off the ground, and ventilated to prevent staining during storage.
- B. Store indoors to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chalfant Manufacturing Company.
 - 2. Cooper B-Line, Inc.
 - 3. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
 - 4. GS Metals Corp.; GLOBETRAYS Products.
 - 5. MONO-SYSTEMS, Inc.
 - 6. MPHusky.
 - 7. PW Industries.

2.2 MATERIALS AND FINISHES

- A. Cable Trays, Fittings, and Accessories: Aluminum, complying with NEMA VE 1, Aluminum Association's Alloy 6063-T6 for rails, rungs, and cable trays, and Alloy 5052-H32 or Alloy 6061-T6 for fabricated parts; with Type 316 stainless-steel splice-plate fasteners, bolts, and screws
- B. Sizes and Configurations: Refer to the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
 - 1. Center-hanger supports may be used only when specifically indicated.

2.3 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 WARNING SIGNS

- A. Lettering: ~~1-1/2-inch-~~ (40-mm-) high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
- B. Materials and fastening are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.
- B. Remove burrs and sharp edges from cable trays.
- C. Fasten cable tray supports to building structure and install seismic restraints.
 - 1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 - 2. Place supports so that spans do not exceed maximum spans on schedules.
 - 3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
 - 4. Support bus assembly to prevent twisting from eccentric loading.
 - 5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
 - 6. Locate and install supports according to NEMA VE 1.

- D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.
- E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.
- F. Make changes in direction and elevation using standard fittings.
- G. Make cable tray connections using standard fittings.
- H. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- I. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- J. Workspace: Install cable trays with enough space to permit access for installing cables.
- K. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- L. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.2 CABLE INSTALLATION

- A. Install cables only when cable tray installation has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. On vertical runs, fasten cables to tray every **18 inches (457 mm)**. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- D. In existing construction, remove inactive or dead cables from cable tray.
- E. Install covers after installation of cable is completed.

3.3 CONNECTIONS

- A. Ground cable trays according to manufacturer's written instructions.
- B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.4 FIELD QUALITY CONTROL

- A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
 2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
 3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
 4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
 5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorquer in suspect areas.
 6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.
- B. Report results in writing.

3.5 PROTECTION

- A. Protect installed cable trays.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.
 3. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

END OF SECTION 260536

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

- B. Related Sections include the following:

1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading: Coordinate all seismic performance requirements with structural engineer.

1.5 SUBMITTALS

- A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 3. Field-fabricated supports.
 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For professional engineer and testing agency.
- F. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to ~~1/4-inch-~~ (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti Inc.
 5. Loos & Co.; Seismic Earthquake Division.
 6. Mason Industries.
 7. TOLCO Incorporated; a brand of NIBCO INC.
 8. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- #### A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four Insert number of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Transient voltage suppression devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Control power.
 - 6. Accessory components and features.
 - 7. Identification.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 - 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.

6. Detail utility company's metering provisions with indication of approval by utility company.
 7. Include evidence of NRTL listing for series rating of installed devices.
 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 9. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
- 1.5 QUALITY ASSURANCE
- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Comply with NEMA PB 2.
- G. Comply with NFPA 70.
- H. Comply with UL 891.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Handle and prepare switchboards for installation according to NECA 400.

1.7 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Architect's [Owner's] written permission.

4. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Front-Connected, Front-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
 2. Branch Devices: Panel mounted.
 3. Sections front and rear aligned.
- C. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Indoor Enclosures: Steel, NEMA 250, Type 1.
- E. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- F. Outdoor Enclosures: Type 3R.
1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
 2. Enclosure: Flat roof; bolt-on rear covers for each section, with provisions for padlocking.
- G. Barriers: Between adjacent switchboard sections.
- H. Insulation and isolation for main and vertical buses of feeder sections.
- I. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- J. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.
- K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- L. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- M. Buses and Connections: Three phase, four wire unless otherwise indicated.
1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity.
 2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.

3. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
 4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- N. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- O. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.
- P. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. Original Equipment Manufacturer (OEM): Listed for use in provided switchboard.
- B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
 2. Fabrication using bolted compression lugs for internal wiring.
 3. Integral disconnect switch.
 4. Redundant suppression circuits.
 5. Redundant replaceable modules.
 6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 7. LED indicator lights for power and protection status.
 8. Audible alarm, with silencing switch, to indicate when protection has failed.
 9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 10. Four-digit, transient-event counter set to totalize transient surges.

- C. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.
- D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
- E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277-V, three-phase, four-wire circuits shall be as follows:
 - 1. Line to Neutral: 800 V for 480Y/277.
 - 2. Line to Ground: 800 V for 480Y/277.
 - 3. Neutral to Ground: 800 V for 480Y/277.
- F. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
 - 1. Line to Neutral: 400 V, 800 V from high leg.
 - 2. Line to Ground: 400 V.
 - 3. Neutral to Ground: 400 V.
- G. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:
 - 1. Line to Line: 2000 V for 480 V.
 - 2. Line to Ground: 1500 V for 480 V.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 - 6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - f. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - i. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.4 INSTRUMENTATION

- A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
 - j. Contact devices to operate remote impulse-totalizing demand meter.
 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.5 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

2.7 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NECA 400.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete Miscellaneous Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Comply with NECA 1.

3.3 CONNECTIONS

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

SWITCHBOARDS

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1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Switchboard will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 262413

SWITCHBOARDS

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Electronic-grade panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.

4. Short-circuit current rating of panelboards and overcurrent protective devices.
 5. Include evidence of NRTL listing for series rating of installed devices.
 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 7. Include wiring diagrams for power, signal, and control wiring.
 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
- C. Qualification Data: For qualified testing agency.
- D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Panelboard Schedules: For installation in panelboards.
- G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NECA 407.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations:

- 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding **minus 22 deg F (minus 30 deg C)** to **plus 104 deg F (plus 40 deg C)**.
 - b. Altitude: Not exceeding **6600 feet (2000 m)**.

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

- 1. Ambient temperatures within limits specified.
- 2. Altitude not exceeding **6600 feet (2000 m)**.

1.9 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Two Insert number spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Surface-mounted cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 4. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - g. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - h. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.

- i. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
- j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
- k. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.5 PANELBOARD SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Current Technology; a subsidiary of Danahar Corporation.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 4. Liebert Corporation.
 - 5. Siemens Energy & Automation, Inc.
 - 6. Square D; a brand of Schneider Electric.
 - 7. Original Equipment Manufacturer (OEM): Listed for use in provided switchboard.
- B. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
 - 1. Accessories:
 - a. LED indicator lights for power and protection status.
 - b. Audible alarm, with silencing switch, to indicate when protection has failed.
 - c. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.
- C. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
 - 1. Accessories:
 - a. Fuses rated at 200-kA interrupting capacity.
 - b. Fabrication using bolted compression lugs for internal wiring.
 - c. Integral disconnect switch.
 - d. Redundant suppression circuits.
 - e. Redundant replaceable modules.
 - f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 - g. LED indicator lights for power and protection status.
 - h. Audible alarm, with silencing switch, to indicate when protection has failed.
 - i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position

- on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- j. Four-digit, transient-event counter set to totalize transient surges.
- 2. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.
 - 3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.
 - a. Line to Neutral: 70,000 A.
 - b. Line to Ground: 70,000 A.
 - c. Neutral to Ground: 50,000 A.
 - 4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
 - 5. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120-V, three-phase, four-wire circuits shall be as follows:
 - a. Line to Neutral: 400 V for 208Y/120.
 - b. Line to Ground: 400 V for 208Y/120.
 - c. Neutral to Ground: 400 V for 208Y/120.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.

- B. Equipment Mounting: Install panelboards on concrete bases, **4-inch (100-mm)** nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around full perimeter of base.
 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Mount top of trim **90 inches (2286 mm)** above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- J. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. **Initial Infrared Scanning:** After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. **Follow-up Infrared Scanning:** Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. **Instruments and Equipment:**
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Snap switches.
 - 4. Cord and plug sets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following—with NEMA configuration as indicated on the drawings:
 - a. Cooper;
 - b. Hubbell; .
 - c. Leviton; .
 - d. Pass & Seymour.

2.5 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Pilot Light Switches, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 - 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

2.7 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.8 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than **6 inches (152 mm)** in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.**G. Arrangement of Devices:** Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.**H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.****3.2 IDENTIFICATION****A. Comply with Division 26 Section "Identification for Electrical Systems."**

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL**A. Perform tests and inspections and prepare test reports.**

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.

2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets for standby power supply with the following features:
 - 1. Diesel engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
 - 4. Performance requirements for sensitive loads.
 - 5. Outdoor enclosure.
- B. Related Sections include the following:
 - 1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 4. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that day tank, engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For installer and manufacturer.
- E. Source quality-control test reports.
1. Certified summary of prototype-unit test report.
 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 5. Report of sound generation.
 6. Report of exhaust emissions showing compliance with applicable regulations.
 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.

2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with ASME B15.1.
- G. Comply with NFPA 37.
- H. Comply with NFPA 70.
- I. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- J. Comply with UL 2200.
- K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- L. Noise Emission: Comply with applicable state and local government requirements for maximum noise level of 72 dB at 10 feet due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Owner no fewer than three days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Owner's written permission.

- B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 4500 feet (1350 m).

1.7 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. These items are specified in Division 07 Section "Roof Accessories."

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 2 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 - 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar; Engine Div.
2. Generac Power Systems, Inc.
3. Kohler Co.; Generator Division.
4. Onan/Cummins Power Generation; Industrial Business Group.
5. Spectrum Detroit Diesel.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- C. Capacities and Characteristics:
 1. Power Output Ratings: Nominal ratings as indicated.
 2. Output Connections: Three-phase, four wire.
 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
 7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
 8. Start Time: Comply with NFPA 110, Type 10, system requirements.
- E. Generator-Set Performance for Sensitive Loads:
 1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

- a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 1, system requirements.

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
- D. Lubrication System: The following items are mounted on engine or skid:
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
 - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 - 1. Minimum sound attenuation of 25 dB at 500 Hz.
 - 2. Sound level measured at a distance of 25 feet (7 m) from exhaust discharge after installation is complete shall be 72 dBA or less.
 - 3. Muffler shall be an insulated pancake type muffler suitable for mounting within the generator enclosure.
- J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- K. Starting System: 24-V electric, with negative ground.
 - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 - 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 - 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 - 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 - 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.

7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
 1. Tank level indicator.
 2. Capacity: Fuel for 24 hours' continuous operation at 100 percent rated power output plus an additional 4 hours of capacity for exercising the generator (28 hours total capacity).
 3. Vandal-resistant fill cap.
 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

- C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gage.
 6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Fuel tank derangement alarm.
 11. Fuel tank high-level shutdown of fuel supply alarm.
 12. Generator overload.
- D. Indicating and Protective Devices and Controls:
1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gage.
 6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Start-stop switch.
 11. Overspeed shutdown device.
 12. Coolant high-temperature shutdown device.
 13. Coolant low-level shutdown device.
 14. Oil low-pressure shutdown device.
 15. Fuel tank derangement alarm.
 16. Fuel tank high-level shutdown of fuel supply alarm.
 17. Generator overload.
- E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."
- G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.

- H. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
 - 1. Engine high-temperature shutdown.
 - 2. Lube-oil, low-pressure shutdown.
 - 3. Overspeed shutdown.
 - 4. Remote emergency-stop shutdown.
 - 5. Engine high-temperature prealarm.
 - 6. Lube-oil, low-pressure prealarm.
 - 7. Fuel tank, low-fuel level.
 - 8. Low coolant level.
- I. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- J. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
 - 1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 - 3. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
 - 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 - 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 - 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 - 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Dripproof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof insulated steel housing, wind resistant up to **100 mph (160 km/h)**. Multiple access doors shall be lockable and provide adequate access to components requiring maintenance. Instruments and control shall be mounted within enclosure. In addition the enclosure shall have the following features:
 - 1. Load Center: Provide with auxiliary devices including, but not limited to the space heater, engine block heater, battery charger, motorized louvers, lights, and outlets.
 - a. Load center: 60-amp, 208-volt, 1-phase, 3-wire.
 - 2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
 - 3. Hinged Doors: With padlocking provisions.
 - 4. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
 - 5. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
 - 6. Muffler Location: Within enclosure.
 - 7. Sound attenuated to 72-dBA at 10-feet.
 - 8. Electric Heater: Within the enclosure, thermostatically controlled to maintain 40-degrees Fahrenheit.
 - 9. Lights: Provide switch and fluorescent light fixtures with sealed lens within enclosure for maintenance visibility.
 - 10. Provide GFI outlet for maintenance.

- B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
 - 2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

2.9 MOTORS

- A. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.10 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to ~~1/4-inch-~~ (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.11 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.

2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Install Schedule 40, black steel piping with welded joints for cooling water piping between engine-generator set and. Piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
- E. Install Schedule 40, black steel piping with welded joints and connect to engine muffler and extend to outside of the enclosure. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
- F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect engine exhaust pipe to engine with flexible connector.
- C. Connect fuel piping to engines with a gate valve and union and flexible connector.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 - 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding **40-inch wg (120 kPa)**. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- 3.6 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 263213

SECTION 271000 - COMMUNICATIONS STRUCTURED CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes wire, cable, connecting devices, patch cords, racks, installation, wire management, and testing for wiring systems to be used as signal pathways for voice and high-speed data transmission. All installation components and procedures are to be in compliance with Utah National Guard Statement of Work Performing Telecommunications Projects UT-G6-C (1/31/08)

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. IDC: Insulation displacement connector.
- C. LAN: Local area network.
- D. PLENUM CABLE: Listed for use in air-handling spaces.
- E. PVC: Polyvinyl chloride.
- F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. General: Include data pertaining appurtenances and accessories:
 - 1. Comply with Division 1 section "Submittals". Include minimum of ten (10) 3-ring binders.
 - 2. Properly mark specific service or function, and intended location of use within project (i.e., voice BDC and IDC termination).
 - 3. Clearly identify or highlight to indicate applicable items.
 - 4. Properly mark with external connection identification as related to the project where they consist of standard factory assembly or field installation drawings.
- B. Product Data: Include data on features, ratings, and performance for each component specified, including but not limited to:
 - 1. Each type of cable.
 - 2. Each type of cable connector.
 - 3. Each type of patch panel.

4. Each type of wire management.
 5. Complete outlet assembly including frame, jacks, and cover plate.
 6. Each type of identification label.
- C. Shop Drawings: Include dimensioned plan and elevation views of each individual component. Show equipment assemblies, method of field assembly, workspace requirements, and access for cable connections.
1. System labeling schedules, including electronic copy of labeling schedules, as specified in Part 3, in software and format selected by Owner.
 2. Wiring diagrams. Show typical wiring schematics including the following:
 - a. Workstation outlets, jacks, and jack assemblies.
 - b. Patch cords.
 - c. Patch panels.
 - d. Fiber-optic boxes.
- D. Cable Administration Drawings: As specified in Part 3.
- E. Samples: For workstation outlets, jacks, jack assemblies, and faceplates for color selection and evaluation of technical features.
- F. Product Certificates: For each type of cable, connector, and terminal equipment, signed by product manufacturer.
1. Certify that the cables are suitable for the connected equipment.
 2. UL labeled and/or listed.
 3. Clearly identify transmission parameters specified (reference category 6 or higher rating).
- G. Manufacturer Seismic Qualification Certification: Submit certification that distribution racks and their components will withstand seismic forces. Include the following:
1. Basis for Certification: Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based. Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity of each rack-mounted component and of each assembled rack type, and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- H. Qualification Data: For Installer.
- I. Provide list of test equipment to be used including documentation indicating that the proposed equipment is capable of performing all of the tests required.
- J. Field quality-control test reports.
- K. Operation and Maintenance Data: For voice and data communication cabling to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: System installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.
 - 1. Factory Certification: Perform installation with factory trained and certified technicians by the manufacturers of the cabling system to be installed.
 - 2. Installation shall be performed by a Systimax certified installer. Pre-approved installers
 - a. Americom Technology
 - b. Cache Valley Electric
 - c. Federal Communications
 - d. Wasatch Electric
- B. Source Limitations: Obtain generic type of products through one source from a single manufacturer, except for the following:
 - 1. Wire Management.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. Comply with FCC Part 68, Chapter 1, "US Code of Federal Regulations, "Title 47 for all telephone system wire and cable connection components.
- F. Comply with latest EIA/TIA, UL, IEEE, and ICEA standards for structured cabling products and installation.
 - 1. "Commercial Building Wiring Standard:" EIA/TIA 568-B.
 - 2. "Commercial Building Standard for Telecommunications Pathways and Spaces:" EIA/TIA 569-A.
 - 3. "Color Marking of Thermoplastic Wire:" EIA-230.
 - 4. Standards pertaining to optical-fiber cable and system component construction and installation: EIA-440, -455, -458, -475, and -509.
 - 5. Certified type PCC FT4 FT6 for plenum cable.
 - 6. ICEA S80-576.
 - 7. UL Subject 444

1.6 COORDINATION

- A. Coordinate layout and installation of voice and data communication cabling with Owner's telecommunications and LAN equipment suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. All work must be coordinated thru the UTNG State Telecommunications Manager (Mike Hansen, pager 801-249-3838) to ensure that UTNG and industry standards are followed.
 - 2. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 3. Record agreements reached in meetings and distribute to other participants.

4. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

1.7 WARRANTY

- A. Special Project Warranty: Manufacturer's standard form in which manufacturer of structured cabling system and the principal installer agree to replace and install structured cabling components that fail in materials or workmanship, or do not meet manufacturer's official published specifications and performance criteria within the Special Project Warranty Period specified below. This includes labor and materials. This warranty shall be in addition to, and not a limitation of, other rights and remedies the Owner may have against the Contractor under the Contract Documents.

1. Warranty Period: 15 years minimum from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Cable: 500 feet (76 m) of each size and type used for Project. Furnish on reels.
 2. Outlet Assemblies: One of each type for every 25 installed, but no fewer than one.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cable:
 - a. CommScope.
 - b. Corning
 2. Terminal and Connector Components:
 - a. Comscope Systemax.
 3. Distribution Racks and Wire Management:
 - a. Chatsworth.

2.2 EQUIPMENT/CABLING LIST

- A. Equip the system with items identified in the Equipment/Cabling List. Do not construe this list as a “bill of materials”. This list identifies items of significance used during the design of the cabling installation. Where the items indicated are one portion of an assembly, provided entire assembly unless specified otherwise.
1. Device part numbers as required by UNG
 - a. CS-SYSTIMX 110UB1-366FT 366 PR BLOCK 110 CAT6 FIELD TERM KIT W/4PR CONN BLAOCKS 108651143 VISIPATCH
 - b. CS-SYSTIMX 110U2R VISIPATCH DISTRIBUTION RING SNAPS ONTO BACK PANEL 108523937 (FOR EVERY 1 OF PART ONE YOU NEED 6 OF THIS PART)
 - c. CS-SYSTIMX 110UTC VISIPATCH TROUGH COVER USED TO HIDE PATCH CORDS 108593203 GRAY
 - d. CS-SYSTIMX 110UHD-S8 VISIPATCH, HORIZONTAL DUCT SNAPS INTO BOTTOM OF VISIPATCH SYSTEM 108637737
 - e. CS-SYSTIMX MGS400BH-262 1-PORT MOD JACK 110 8W8P UTP T568A/B CAT6 GIGASPEED 700206725 ELEC. WHITE
 - f. CS-SYSTIMX M12L-262 2-PORT FLUSH MT UNLOADED SGL GANG M-SERIES 108168469 WHITE
 - g. CS-SYSTIMX CPC5512-03F003 CBL ASSY 110 24-4PR STRANDED CAT6 T568B 3FT VISIPATCH CPC5512-03F003 GRAY
 - h. CS-SYSTIMX CPC5512-03F003 CBL ASSY 110 24-4PR STRANDED CAT6 T568B 5FT VISIPATCH CPC5512-03F005 GRAY
 - i. CS-SYSTIMX CPC5512-03F003 CBL ASSY 110 24-4PR STRANDED CAT6 T568B 7FT VISIPATCH CPC5512-03F007 GRAY
 - j. CS-SYSTIMX CPC5312-03F007 CBL ASSY 110-MOD 24-4PR STR CAT6 T568B 7FT VISIPATCH CPC5312-03F007 GRAY
 - k. CS-SYSTIMX CPC5312-03F005 CBL ASSY 110-MOD 24-4PR STR CAT6 T568B 5FT VISIPATCH CPC5312-03F005 GRAY
 - l. CS-SYSTIMX CPC5312-03F003 CBL ASSY 110-MOD 24-4PR STR CAT6 T568B 3FT VISIPATCH CPC5312-03F003 GRAY
 - m. CS-SYSTIMX CPC5312-03F025 CBL ASSY 110 24-4PR STRANDED VISIP-RJ-45 CAT6 T568B 25FT GRAY CPC5312-03F025
 - n. CS-SYSTIMX 600G2-1U-MOD-SD MODULAR COMBINATION SHELF SLIDE ACCEPT 4 MODULES 760028324
 - o. CS-SYSTIMX MODG2-6SC-MM 6 MODULE ADAPTER BEIGE 72 MAX FIB MODG2-6SC-MM 760032177
 - p. CS-SYSTIMX P6201B-Z 125 SC CONNECTOR MM CER EZ&EPOXY OC 900UM ONLY, NON-TUNABLE 760007070
 - q. COMMSCOPE 75N4 (CAT 6 BLUE)
 - r. COMMSCOPE 75N4 (CAT 6 YELLOW)
 - s. MARCONI R66P25QC LIGHTING PROTECTION PANEL
 - t. MARCONI R66P50QC LIGHTING PROTECTION PANEL
 - u. MARCONI R66P100QC LIGHTING PROTECTION PANEL
- GAS PROTECTION FUSES 104410147

2.3 SYSTEM REQUIREMENTS

- A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.
- B. Expansion Capability: Unless otherwise indicated, provide positions in cross-connect, patch panels, and mounting space on each backboard or in each rack to accommodate 20 percent future increase in outlets of each type.
- C. Equipment Capability: Unless otherwise indicated, provide 100% of patch panel and wire management space in each rack for owner furnished equipment.

2.4 MOUNTING ELEMENTS

- A. Raceways and Boxes: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems."
- B. Backboards: 3/4-inch (19-mm), interior-grade, painted fire-retardant-treated plywood floor.
- C. Distribution Racks: Modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.

2.5 TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

- A. UTP Station Cable: Comply with TIA/EIA-568-B. Four, thermoplastic-insulated, individually twisted pairs of conductors; No. 24 AWG, color-coded; enclosed in PVC jacket. Listed as complying with TIA/EIA-568-B.
 - 1. Category 6, as indicated on the drawings.
 - 2. Conductors: Solid copper.
 - 3. Plenum.
- B. UTP Cable Connecting Hardware: Comply with TIA/EIA-568-B. IDC type, using modules designed for punch-down caps or tools, and rated for the category rating of the cable.
 - 1. IDC Terminal Block Modules: Integral with connector bodies, including plugs and jacks where indicated.
 - 2. IDC Connecting Hardware: Consistent throughout Project.
- C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to satisfy specified expansion criteria.
 - 2. Mounting: Backboard.
- D. Jacks and Jack Assemblies for UTP Cable: Modular, color-coded, RJ-45 receptacle units with integral IDC-type terminals. Use keyed jacks for data service.
 - 1. Match category rating of jack to category rating cable terminated, unless indicated otherwise.
 - 2. 8-pin modular jack, IDC type, in compliance with 568B wiring specifications; jack to be removable (modular) from a frame or faceplate.

- E. UTP Patch Cords: Four-pair cables in 48-inch (1200-mm) and 36-inch (900-mm) lengths, terminated with RJ-45 plug at each end. Use keyed plugs for data service.
- F. Workstation Outlets: Number of jack-connector assemblies mounted in single or multigang faceplate as shown.
 - 1. Faceplate: High-impact plastic; color as selected by Architect.
 - 2. Mounting: Flush, unless otherwise indicated.
 - 3. Legend: Labeled with labeling system manufactured by the faceplate manufacturer.

2.6 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Corning Cable Systems.
- B. Description: Multimode, 50/125-micrometer, 6-fiber, conductive, tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 - 3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
 - b. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
 - c. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666.
 - 5. Conductive cable shall be steel or aluminum armored type.
 - 6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 - 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- C. Single Mode Cables: Factory fabricated, jacketed, low loss, glass type, fiber optic, singlemode, graded index, operating at 1310 and 1550 nm.
 - 1. Individually insulated plenum rated strands under common plenum rated sheath.
 - 2. Provide quantity of fibers as indicated.
 - 3. Comply with ANSI/TIA/EIA 568-B.3 and all addendums.
 - 4. Core diameter is between 8 and 9 μm , Cladding diameter is to be 125 μm
 - 5. Maximum attenuation is 0.5 dB/km @ 1310 and 1550 nm.
 - 6. Bandwidth of greater than 20 GHz
- D. Jacket:
 - 1. Jacket Color: Aqua for 50/125-micrometer cable.
 - 2. Jacket Color: Organge for single mode cable.

3. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
4. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.7 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Systimax
 2. Secor
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.
- D. Cable Connecting Hardware:
 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.8 IDENTIFICATION PRODUCTS

- A. Comply with Division 26 Section "Identification for Electrical Systems" and the following:
 1. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Refer to Division 26 drawings for additional locations of outlets, communication rooms, and cable trays.
 2. Provide inner duct for all fiber optic cables installed in cable tray, loose, or in conduit with diameters in excess of 1.5 inches.

3.2 APPLICATION OF MEDIA

- A. Horizontal Cable for Data Service: Refer to drawings for cable for runs between wiring closets and workstation outlets.
- B. Horizontal Cable for Voice Service: Refer to drawings for cable for runs between wiring closets and workstation outlets.

3.3 INSTALLATION

- A. Wiring Method: Install wiring in raceway and cable management systems except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
 - 1. Where raceways are not provided, install cabling in accessible ceilings, minimum 18" above suspended ceiling. Support cable a minimum of every 30" from the building structure. Do not support cable from suspended ceilings. Install cables above accessible ceilings in common areas and corridors to the furthest possible point for convenient access.
- B. Install cables using techniques, practices, and methods that are consistent with Category rating of the cable installed and that ensure the performance of the completed and linked signal paths, end to end, of the category rating indicated.
- C. Install cables without damaging conductors, shield, or jacket.
- D. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
- E. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
 - 1. Pull cables simultaneously if more than one is being installed in same raceway.
 - 2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
 - 3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.
- F. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
- G. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- H. Wiring within Wiring Closets and Enclosures: Provide conductors of adequate length. Train conductors to terminal points with no excess. Use wire distribution spools at points where cables are fanned or conductors turned. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer. Connect conductors that are terminated, spliced, or interrupted to terminal blocks. Label each terminal with designations approved by the Owner. Install wiring on racks and at wall mounted connection blocks through wire management devices.

- I. Separation of Wires: Comply with TIA/EIA-569-A rules for separating unshielded copper voice and data communication cabling from potential EMI sources, including electrical power lines and equipment.
 - 1. Do not install structured cabling within 12" of power and lighting wiring, or within 12" of a fluorescent lighting and electrical fixtures.
- J. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
- K. Use splice and tap connectors compatible with media types.
- L. Riser Cables: Install all riser cables through 5" sleeves. Support riser cable through sleeves at a minimum of even floor number intervals. Select support system based on site conditions and weight of cable.

3.4 GROUNDING

- A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Ground and bond all equipment racks and wall fields. Provide grounding connections for cable and other system components as required by manufacturer's written instructions and TIA/EIA 607-A, "Grounding and Bonding of Telecommunications Systems".
 - 1. Terminate all ground conductors to ground terminals or ground buses in equipment rooms and wiring closets.
 - 2. Conductors: Minimum #6 AWG, THWN, Copper, color coded green.
- C. Signal Ground Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
- D. Signal Ground Bus: Mount on wall of main equipment room with standoff insulators.
- E. Signal Ground Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.5 INSTALLATION IN EQUIPMENT ROOMS AND WIRING CLOSETS

- A. Install plywood backboards on walls of equipment rooms and wiring closets from floor to ceiling.
- B. Mount patch panels, terminal strips, and other connecting hardware on backboards, unless otherwise indicated.
- C. Group connecting hardware for cables into separate logical fields.
- D. Use patch panels to terminate cables entering the space, unless otherwise indicated.

3.6 INSTALLATION STANDARDS

- A. Comply with requirements in TIA/EIA-568-B and TIA/EIA-569-A.

3.7 IDENTIFICATION

- A. In addition to requirements in this Article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems" and TIA/EIA-606-A.
- B. System: Use a unique, three-syllable, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement.
 - 1. First syllable identifies and locates equipment room or wiring closet where cables originate.
 - 2. Second syllable identifies and locates cross-connect- or patch-panel field in which cables terminate.
 - 3. Third syllable designates type of media (copper or fiber) and position occupied by cable pairs or fibers in field.
- C. Workstation: Label cables within outlet boxes.
- D. Distribution Racks and Frames: Label each unit and field within that unit.
- E. Within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Cables, General: Label each cable within **4 inches (100 mm)** of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
- G. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding **15 feet (4.5 m)**.
- H. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project, in software and format selected by Owner.
 - 1. Provide cable records on an automated dBase or Excel compatible program. Establish fields for recording of active and inactive cable pairs to be input by Owner's personnel at a later date. Correlate WSI number, distribution cable number, punch down block or frame assignments, conduit or duct path and station location. Update record as the project progresses to reflect required changes.
- I. Cable Administration Drawings: Show building floor plans with cable administration point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
 - 1. Drawing Format: AutoCAD 2000.

3.8 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
 - a. Test from each main equipment room (MDF) termination block to each corresponding telecommunications closet (IDF) termination.
 - b. Test from each telecommunications closet (IDF) termination to each and every workstation termination.
 - c. Test any other telecommunications inter-building or station cable which forms a portion of this installation.
 - d. Configure Test Equipment to test the maximum transmission performance for which the cable is rated (i.e., Cat 3=10 Mbps, Cat 5=100Mbps, Cat 5e=350 Mhz, Cat 6=1 Ghz.
2. Copper Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts.
 - a. Use Class 2, bidirectional, Category 6 tester, Microtest Omni Scanner2 & Kit (Version 4.0). Test for faulty connectors, splices, and terminations. Test according to TIA/EIA 568-B, "Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems." Link performance for UTP cables must meet minimum criteria of TIA/EIA-568-B.

B. Record of Test Results:

1. Provide record of all required tests to the Engineer and Owner for a permanent record for the purposes of maintenance and restoration.
2. Provide brief description outlining the test equipment used and a single line diagram indicating the test setup. The level of description should be sufficient enough to allow an individual who is not familiar with the specific test equipment to recreate any portion of the test.
3. Include the following minimum information:
 - a. For all similar cable runs include:
 - 1) Project name.
 - 2) Description of test (i.e., voice riser, workstation cable, etc.
 - 3) Cable origin.
 - 4) Cable destination.
 - 5) Cable ID.
 - 6) Cable pair/strand.
 - 7) Test date.
 - 8) Tester (individual responsible for conducting the test).
 - 9) Page _____ of _____
 - 10) An initial block for Owner witness for each separate testing requirement.
 - 11) A signature block for the Owner witness.

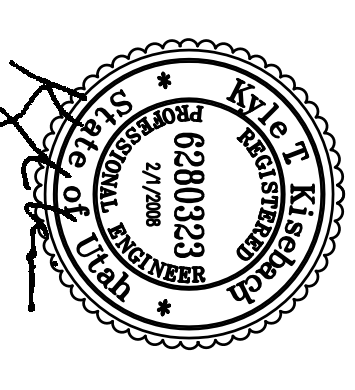
- b. For copper cables:
 - 1) No shorts, no crosses, no breaks.
 - 2) For the indicated pairs of the cables include:
 - a) Length
 - b) Resistance
 - c) Noise @ 10Hz-150 Khz, 150KHz – 15 Mhz, 16 Mhz – 100 Mhz, 110 Mhz – 250Mhz.
 - d) Attenuation (dB) at 10 Mhz
 - e) Near end cross talk (NEXT) and the associated frequency
 - f) Wire map
 - g) Test equipment settings
 - c. Record documents will be a permanent record; therefore, take care in recording test results that the final product is expected to be done in a neat legible manner.
 - d. Provide test results in the following formats:
 - 1) Printed (3 bound copies).
 - 2) Disk (DOS formatted – 3.5")
- C. Remove malfunctioning units, replace with new units, and retest as specified above.
- 1. Any defects or deficiencies discovered in any of the telecommunications work shall be indicated on the test report and corrected.
 - 2. Upon completion of testing and problem resolution, all connections tested are to be 100% error free for all horizontal workstations.
 - 3. Indicate any connections determined to be not correctable at each end of the termination as “bad” (in red) – backbone/riser.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and extending wiring to establish new workstation outlets. Refer to Division 1 Section "Closeout Procedures."
- 1. Include a description of the systems, a tour of the facilities, and a tutorial on using the cable testers and documentation software.
 - 2. Include sufficient level of training to the Owner's staff to allow for installation and maintenance to be carried out to the manufacturer's specifications.
 - 3. Subsequent to hookups of telephone/data distribution systems, operate control/signal systems to demonstrate proper functioning. Replace malfunctioning media with new materials, and then retest until satisfactory performance is achieved.
 - 4. Documentation: Use the above time domain reflectometer to make a strip chart recording of transmission characteristics, wave form, and performance of all segments of the installation at the time of commissioning. Also, use an optical loss test set (OLTS) to measure the optical transmission loss on each optical fiber path in the system. Record loss data in a form with provision for at least 50 additional loss data entries during future maintenance operations. Bind the recordings in a cable record book indexed for easy

reference during future maintenance operations and turn book over to the Owner's
authorized representative.

END OF SECTION 271000



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NORTH SALT
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TEAM

Salt Lake City, UT

BID SET
FIRST FLOOR
MECHANICAL PLAN

PROJECT NO.
2008-00000000
DATE
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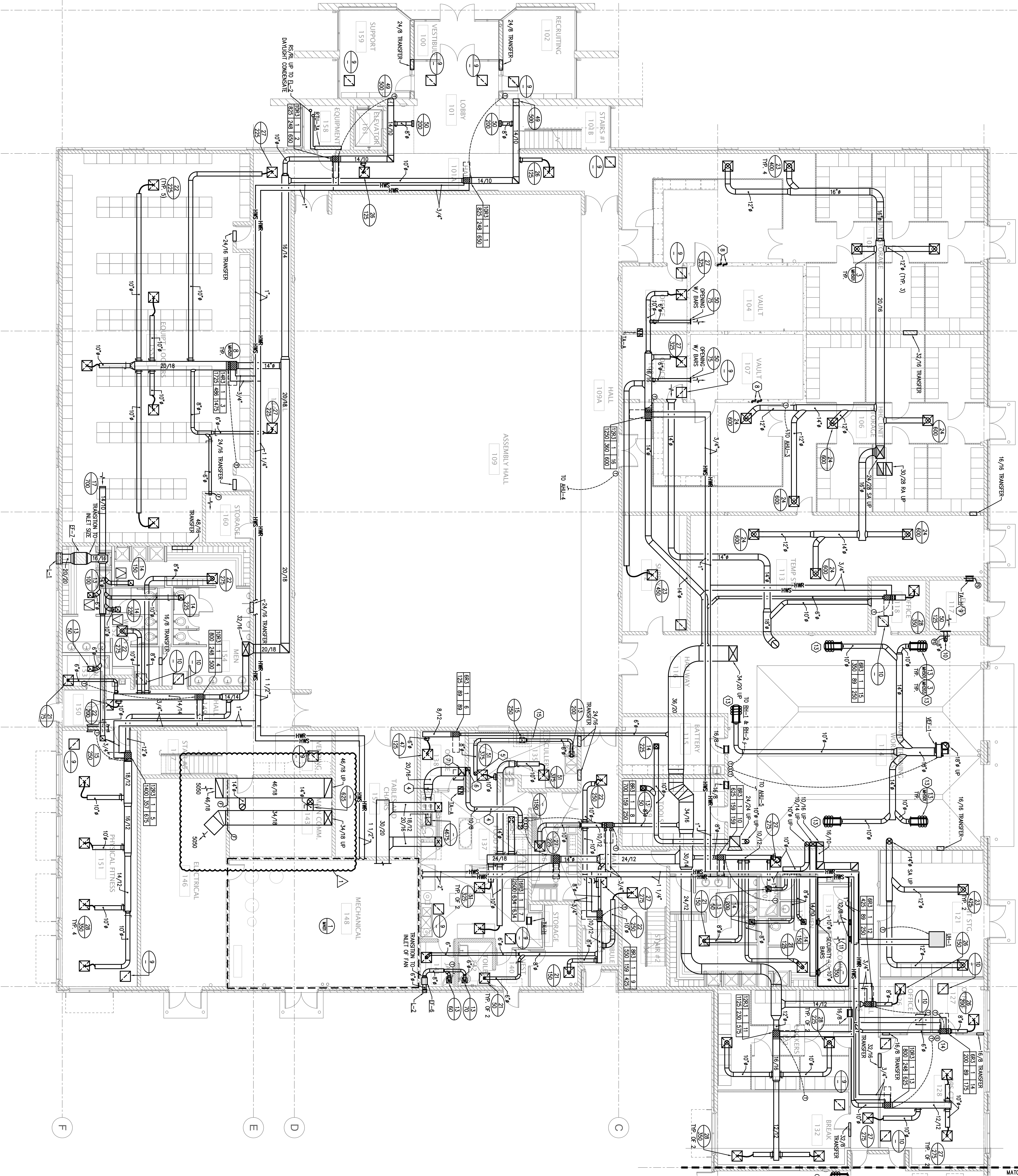
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KEYED NOTES

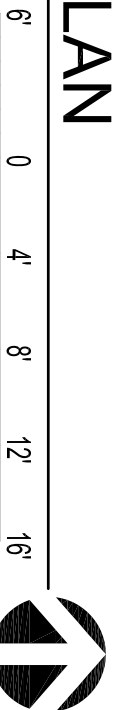
- 1 MOUNT UNITS 12' ABOVE FINISHED FLOOR.
- 2 8" WALL CAP.
- 3 20" WALL CAP.
- 4 TYPE I EXHAUST WELDED 18 GA FIRE MASTER WRP.
- 5 6" EXHAUST DUCT UP TO EC-3.
- 6 10/6 EXHAUST DUCT UP TO EC-4.
- 7 20/16 TYPE I EXHAUST DUCT UP TO EC-5.
- 8 PROVIDE (2) 1 1/2" Z-DUCTS THRU WALL FROM VAULT TO UNIT STORAGE. LOCATE Z-DUCTS AT 12' AFF AND 12' BELOW VAULTED CEILING. CENTER SECTION TO BE MINIMUM 6' LONG.
- 9 TRANSFER DUCT MUST BE MOUNTED WITHIN 12' AFF.
- 10 DEFROST MUST BE MOUNTED WITHIN 12' AFF.
- 11 DRAINAGE ARE SHOWN SCHEMATICALLY DO NOT RUN ANY PIPE IN COMMUNICATION ROOMS.
- 12 TRANSFER SPLIT DUCTS TO SUPPLY AIR INLETS OF KITCHEN HOOD.
- 13 MOUNT REEL ON WALL APPROXIMATELY 14' ABOVE FINISHED FLOOR.
- 14 MAINTAINED MUSHROOM KILL SWITCH. SEE WH001, SCHEMATIC 4.
- 15 TYPE II VENT, 304 STAINLESS STEEL.

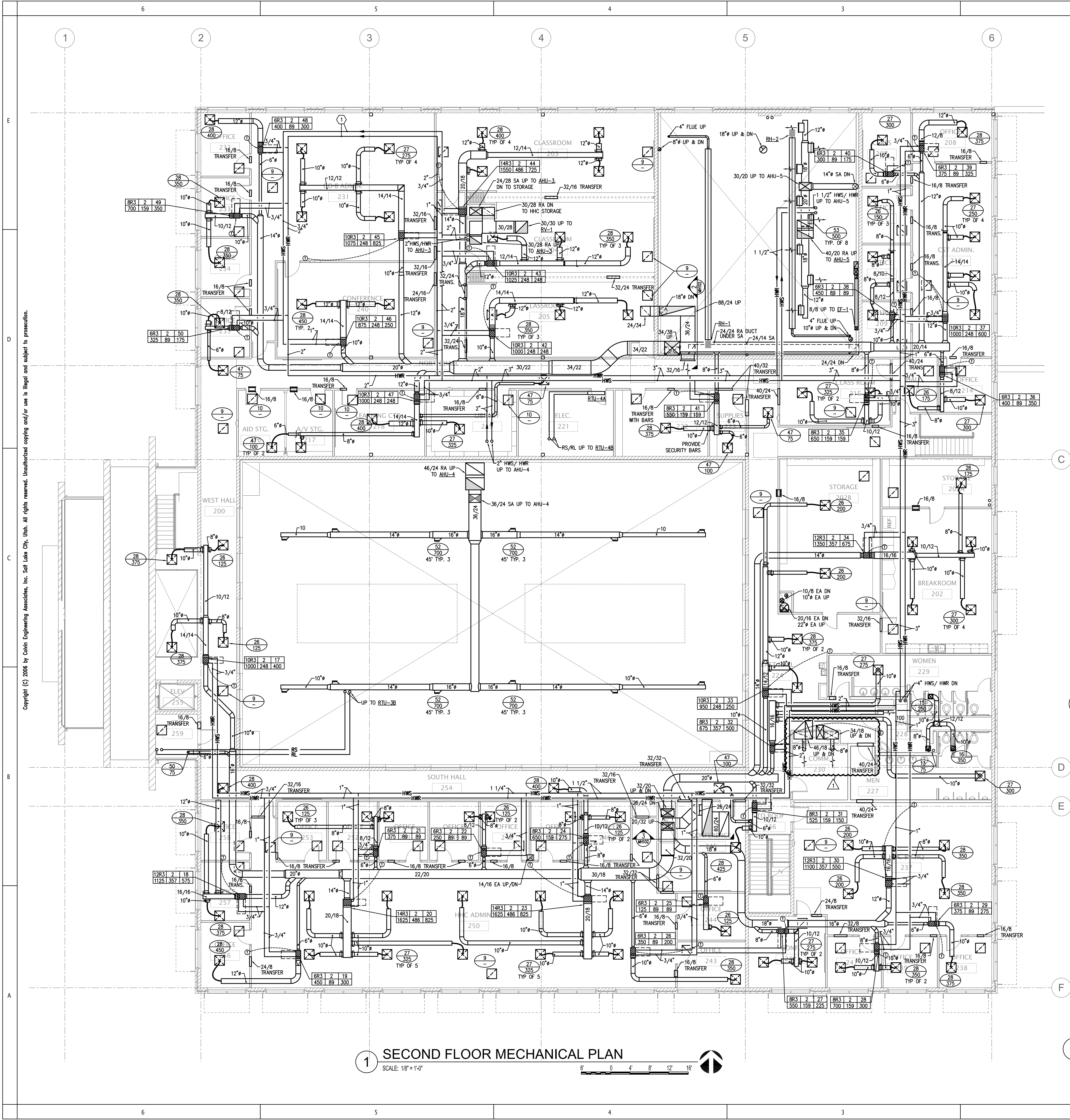
GENERAL NOTES

- A ALL RETURN AIR TRANSFERS TO BE LOCATED IN BEAM POCKET.
- B COORDINATE ALL GRILLES WITH ARCHITECTURAL CEILING PLANS. SEE AEL21.
- C SEE DETAILS 235 ON WH001 FOR DUCT INSTALLATION.



1 FIRST FLOOR MECHANICAL PLAN





KEYED NOTES

① LOCATION OF HEATING WATER LOOP DIFFERENTIAL PRESSURE SENSOR.

GENERAL NOTES

① ALL RETURN AIR DUCT TRANSFERS ARE TO BE LOCATED IN BEAM POCKET.

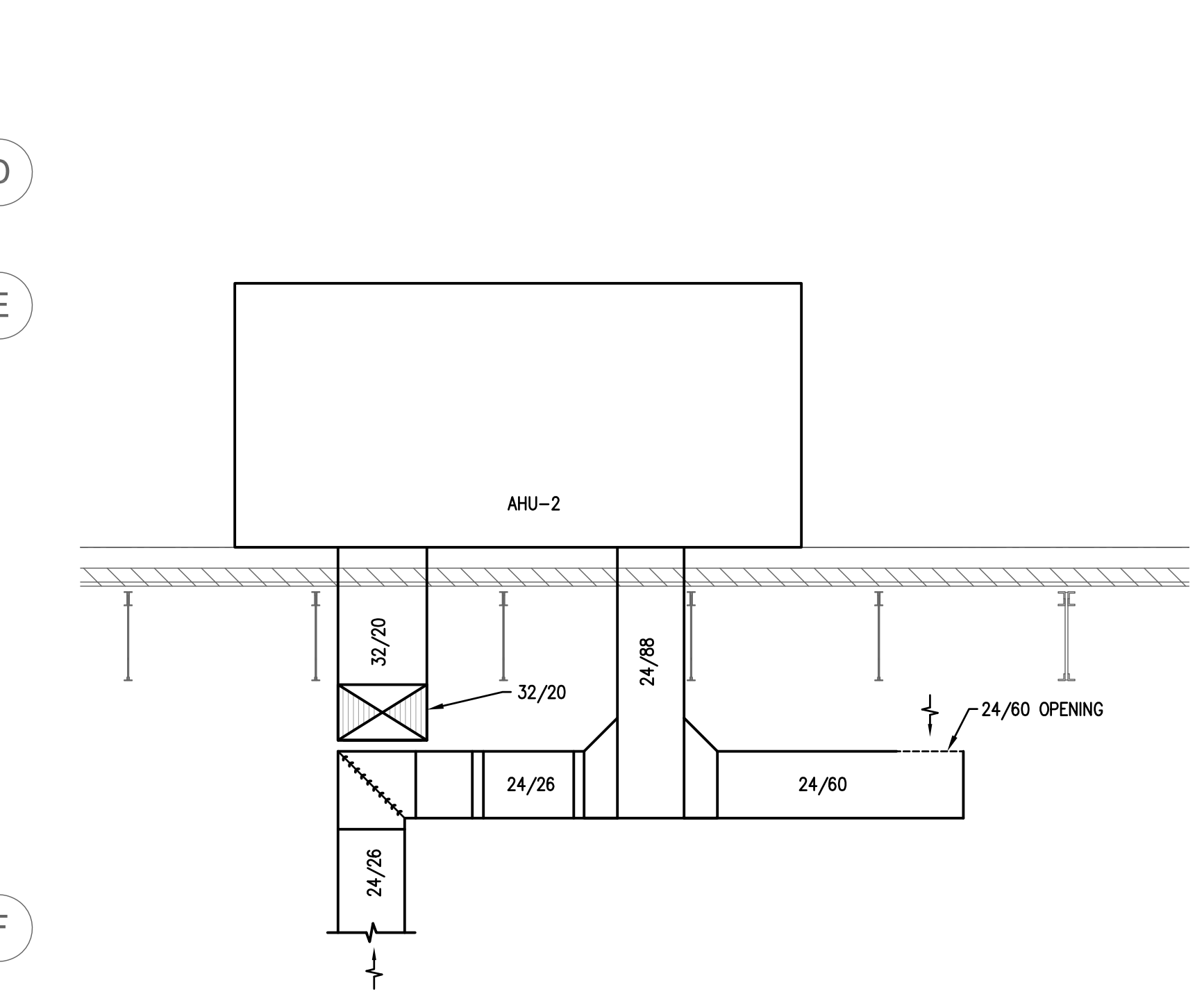
② ALL RETURN AIR GRILLES ARE SCHEDULE 10 UNLESS OTHERWISE NOTED. SEE M601 FOR AIR DEVICE SCHEDULE.

③ COORDINATE ALL GRILLES WITH ARCHITECTURAL CEILING PLANS. SEE AE128.

④ SEE DETAILS 2.3.5 ON MH501 FOR DUCT INSTALLATION.

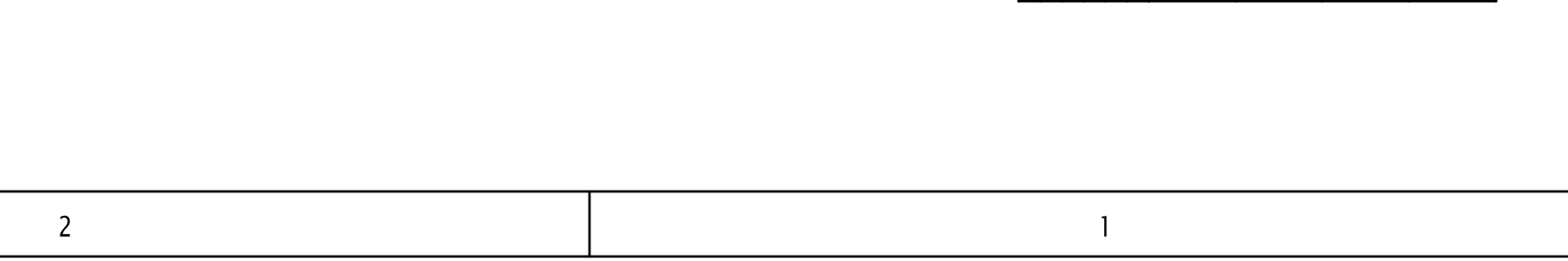
② AHU-1 DUCT SECTION

SCALE: 1/4" = 1'-0"



③ AHU-2 DUCT SECTION

SCALE: 1/4" = 1'-0"



① SECOND FLOOR MECHANICAL PLAN

SCALE: 1/8" = 1'-0"

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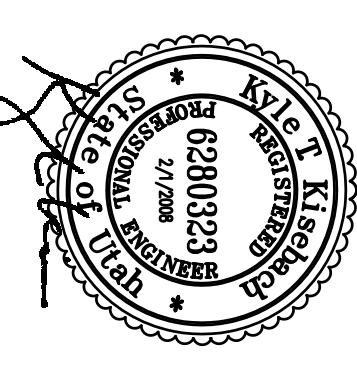


NORTH SALT LAKE READINESS CENTER AND CIVIL SUPPORT TEAM

Salt Lake City, UT

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SECOND FLOOR MECHANICAL PLAN

PROJECT NO. 2006-095-00	MH102
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NORTH SALT
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SALT LAKE CITY, UT

BID SET
ROOF MECHANICAL
PLAN

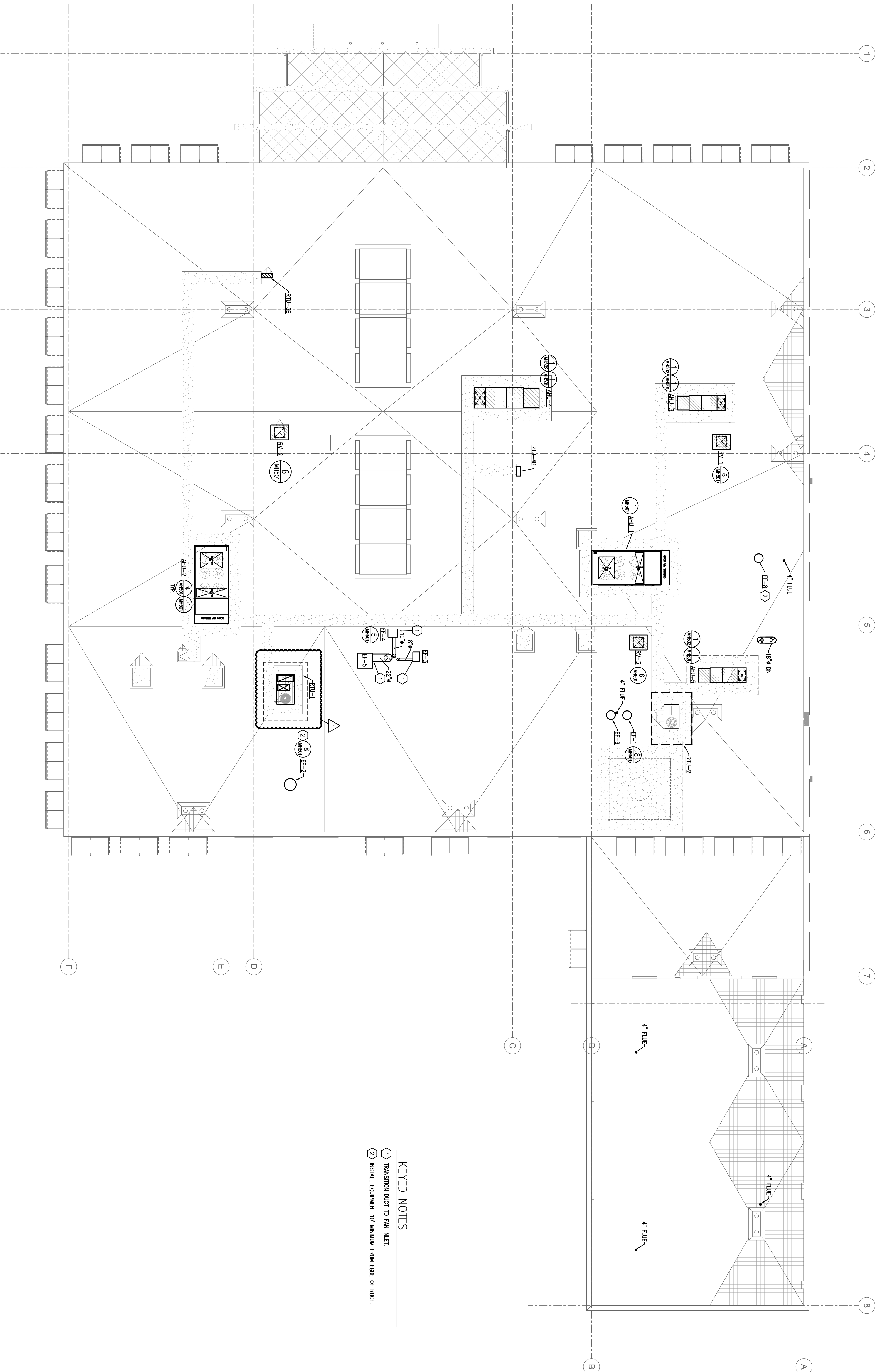
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1 ROOF MECHANICAL PLAN

SCALE: 3/32" = 1'-0"



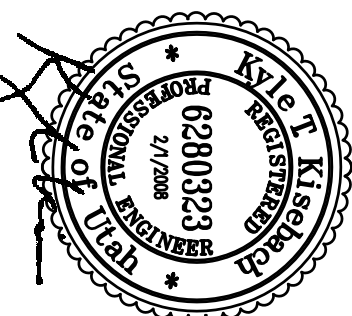
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KEYED NOTES

- 1 TRANSITION DUCT TO FAN INLET.
- 2 INSTALL EQUIPMENT TO MINIMUM FROM EDGE OF ROOF.

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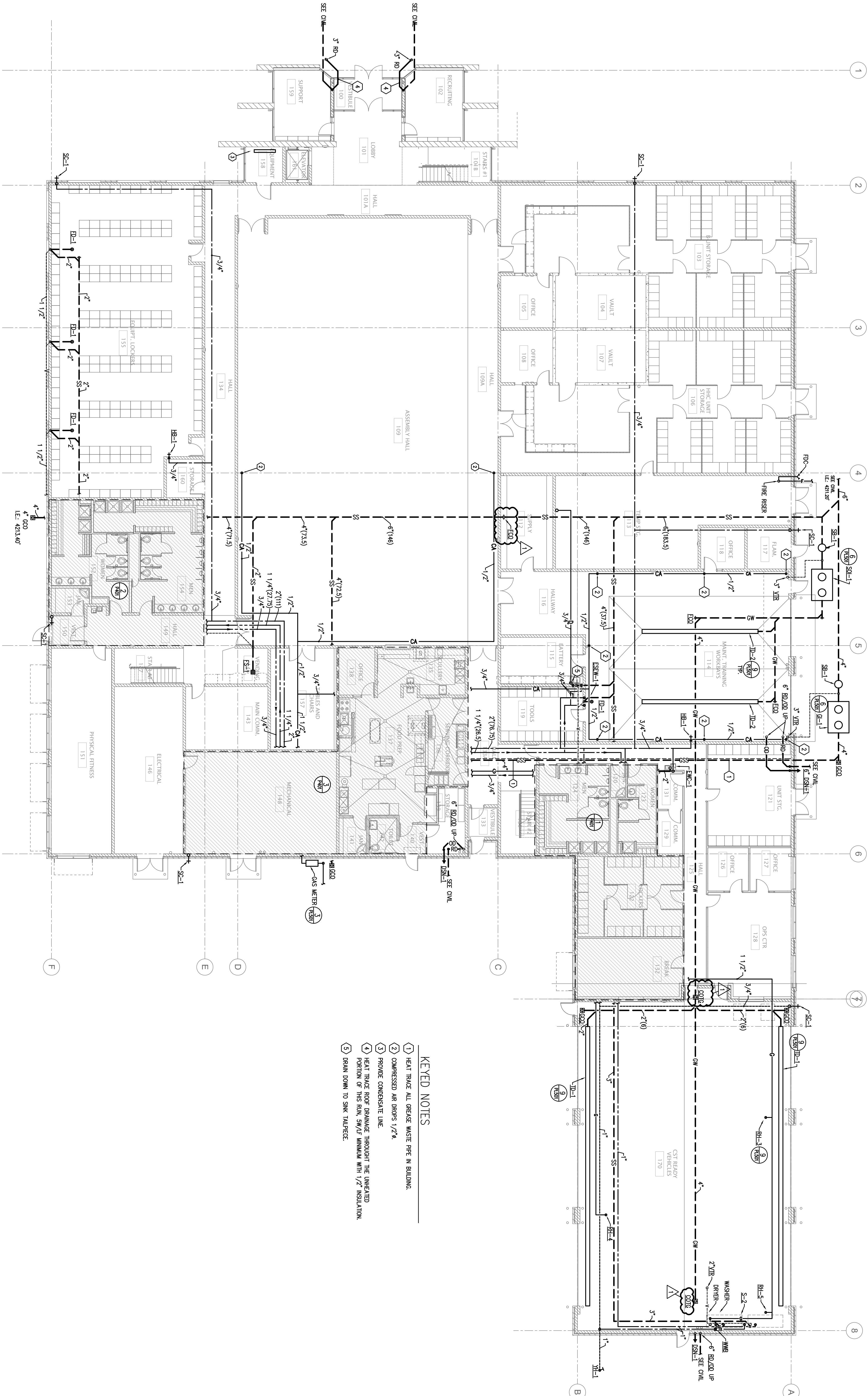


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KEYED NOTES

- ① HEAT TRACE ALL GREASE WASTE PIPE IN BUILDING.
- ② COMPRESSED AIR DROPS 1/2".
- ③ PROVIDE CONDENSATE LINE.
- ④ HEAT TRACE ROOF DRAINAGE THROUGHT THE UNHEATED PORTION OF THIS RUN, 5W/1F MINIMUM WITH 1/2" INSULATION.
- ⑤ DRAIN DOWN TO SINK TAILPIECE.



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FIRST FLOOR PLUMBING PLAN

PROJECT NO. 2006-095.00	PL101
DATE 2/1/2008	

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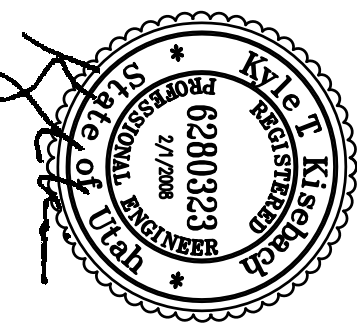
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1 FIRST FLOOR PLUMBING PLAN





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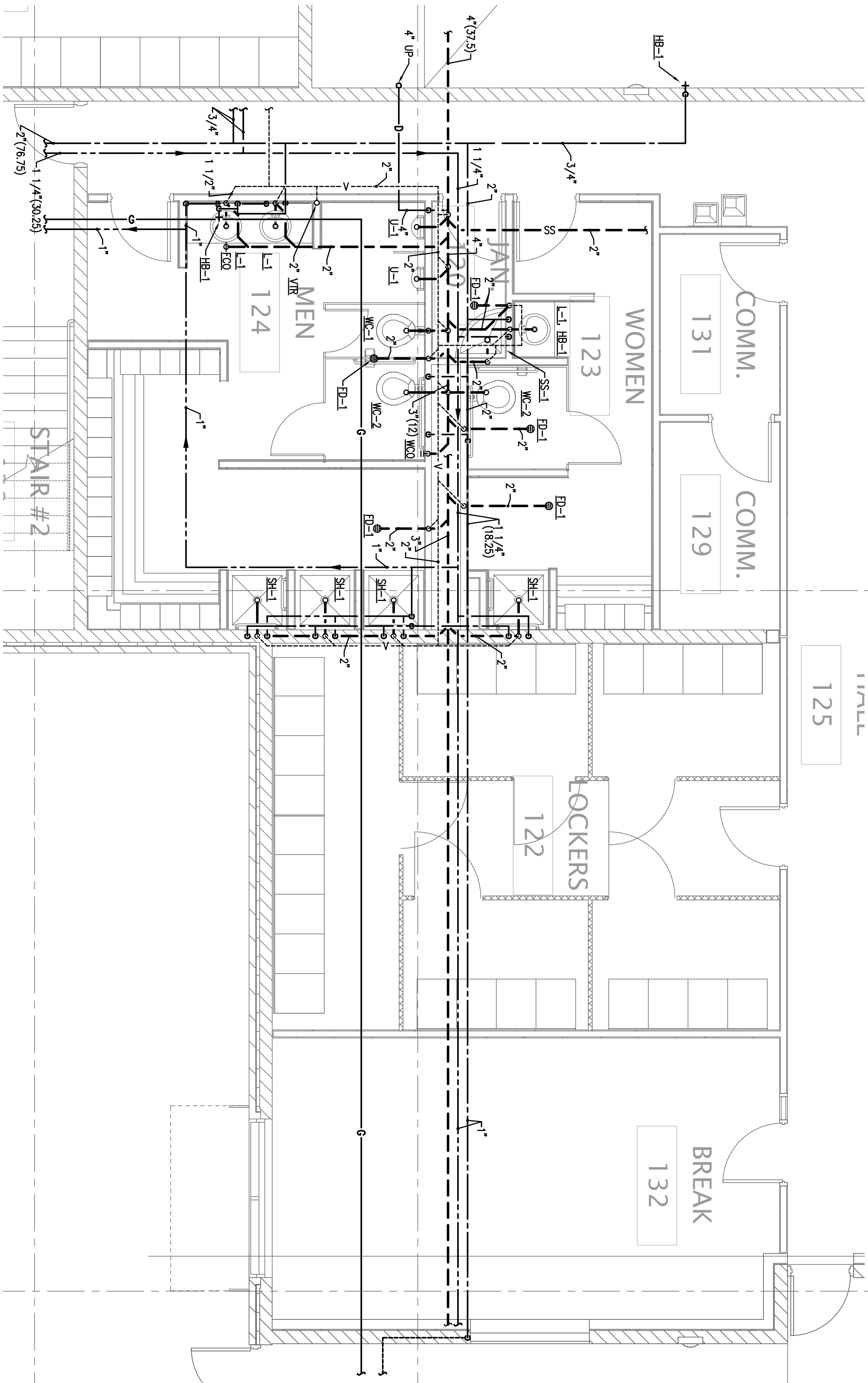
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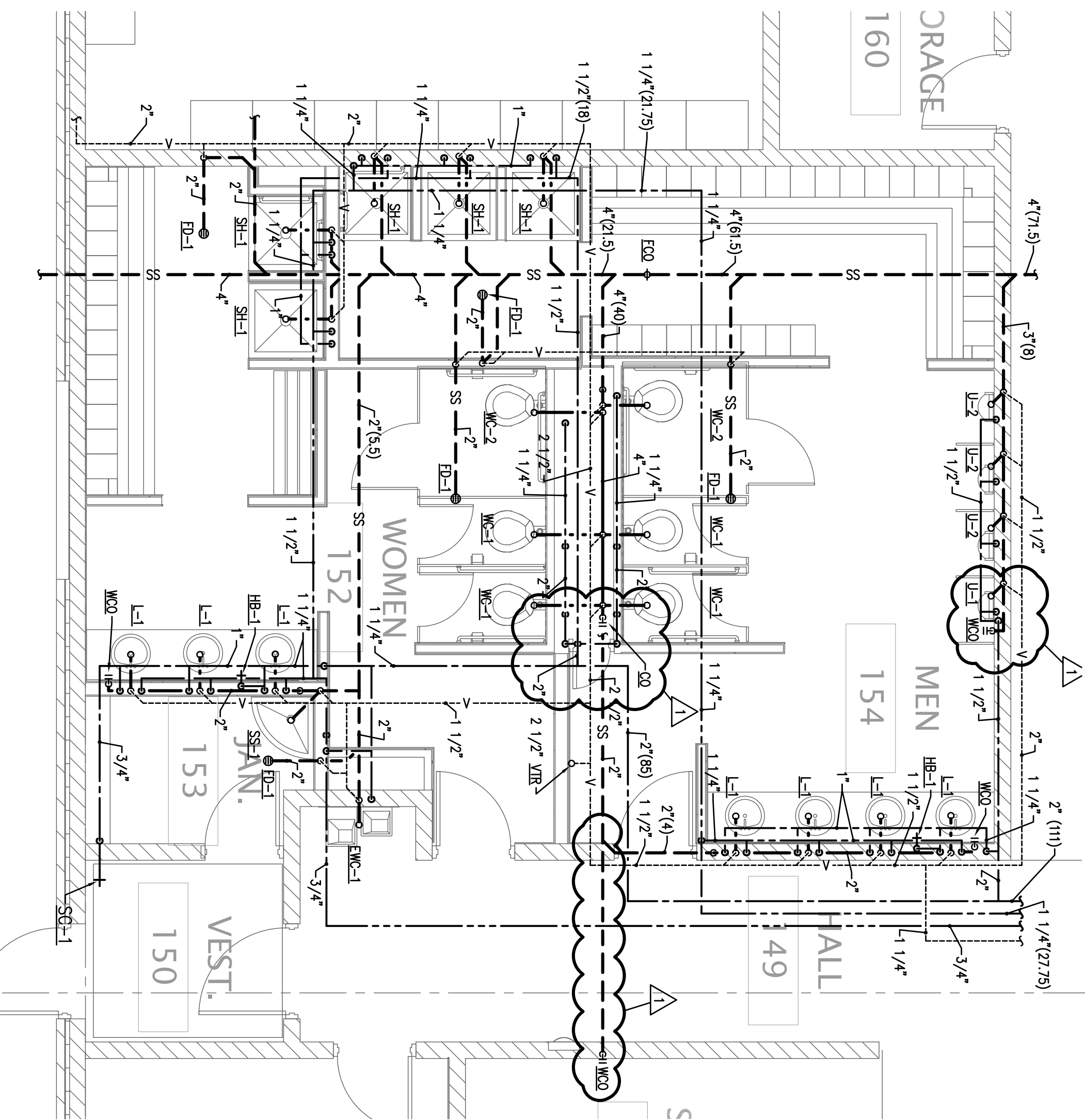
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1 ENLARGED FIRST LEVEL RESTROOM PLUMBING

SCALE: 1/4"=1'-0"



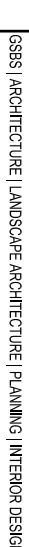
2 ENLARGED FIRST LEVEL RESTROOM PLUMBING

SCALE: 1/4"=1'-0"

- KEYED NOTES
- 1 1/4" HW AND 2" CW UP TO LEVEL TWO RESTROOM.
 - 3/4" HW REGULATION LINE UP TO LEVEL TWO RESTROOM.
 - FOR FUTURE AIR COMPRESSOR.
 - PROVIDE BYPASS FOR FUTURE WATER SPLITTER.
 - 1" DRAIN, 3/4" CW TO EVAPORATIVE COOLER. PROVIDE BACKFLOW PREVENTION ON CW LINE.
 - 1 1/4" HW LINE TO WATER WASH HOOD. PROVIDE 2" DIRECT DRAIN TO CSS VIA FLOOR SINK/FRENCH DRAIN.
- GENERAL NOTES
- HEAT TRACE ALL CSS PIPING IN BUILDING.
 - SEE KITCHEN PLANS FOR DIMENSION OF FLOOR SINKS, FLOOR GRABS AND ALL STUB-OUTS FOR CW, HW, GAS, ETC.

3 ENLARGED FIRST LEVEL KITCHEN AND MECHANICAL ROOM PLUMBING

SCALE: 1/4"=1'-0"



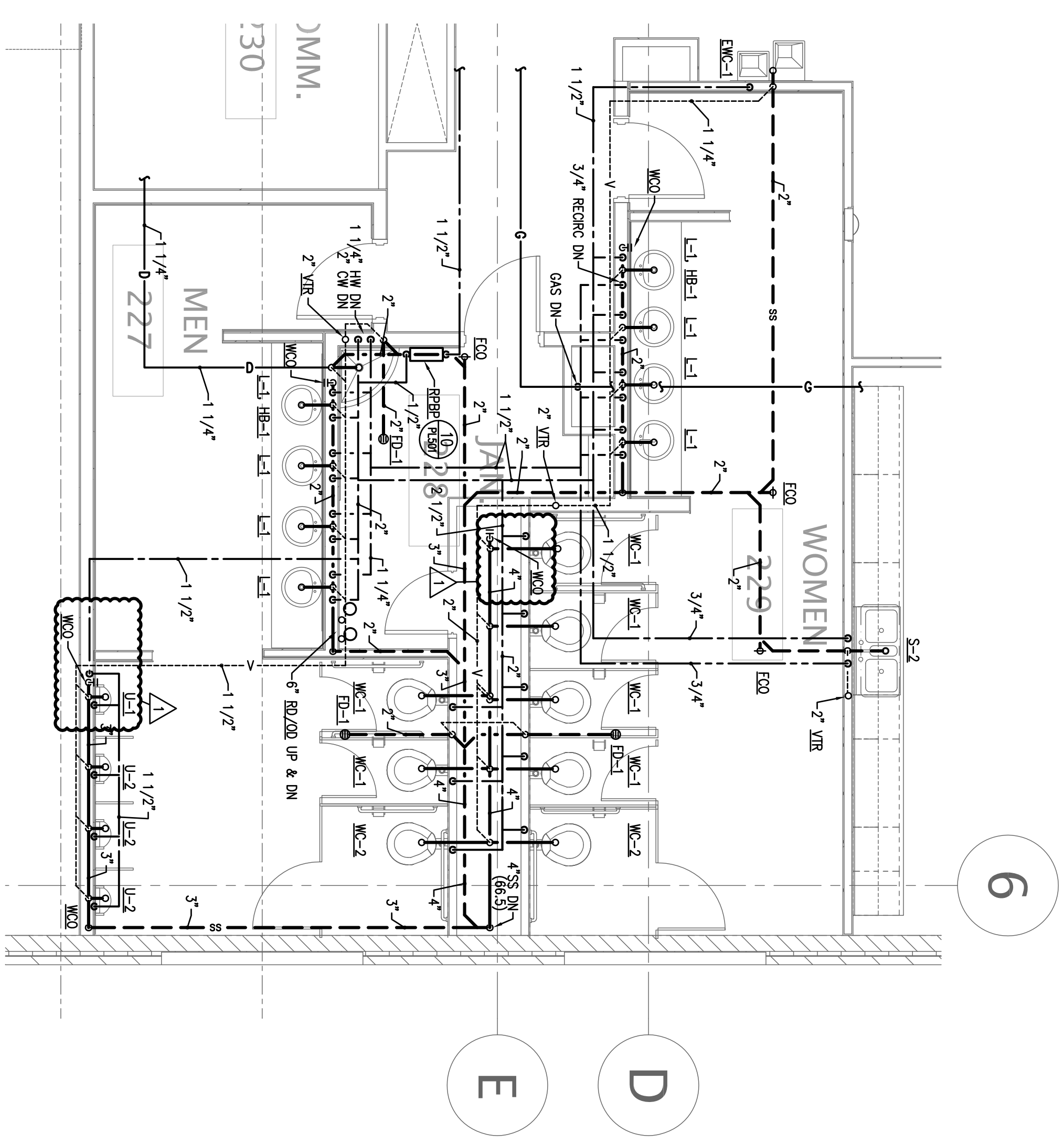
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1 ENLARGED SECOND LEVEL RESTROOM PLUMBING



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ENLARGED PLUMBING PLANS

PROJECT NO. 2006-095.00	PL402
DATE 2/1/2008	

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SECTION 230500 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Basic requirements common to the work in general of Division 23 and other Divisions and Sections of the Specification where referenced.
- B. Provide, unless specified otherwise, all labor, materials and equipment necessary for completely finished and operational mechanical systems described and specified under other Sections of this Division 23.
- C. LEED Compliance: This project is to meet or exceed the Gold Level of the United States Green Building Council's LEED-NC requirements. Contractor shall be familiar with these requirements and provide all necessary work, systems, and equipment to achieve the following LEED points:
 - 1. Fundamental Building Systems Commissioning
 - 2. Minimum Energy Performance (meet ASHRAE/IESNA 90.1-1999)
 - 3. CFC Reduction in HVAC&R Equipment
 - 4. Optimize Energy Performance (25% reduction in energy usage)
 - 5. Measurement and Verification
 - 6. Minimum IAQ Performance
 - 7. IAQ Monitoring
 - 8. Construction IAQ: Management Plan
 - 9. Construction IAQ: Flush-out or testing
 - 10. Thermal Comfort: Temperature & Humidity
 - 11. Thermal Comfort: Monitor/Control
 - 12. Acoustic Environment/Noise Control
- D. During construction meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings under Construction, 1995, AND protect stored on-site or installed absorptive materials from moisture damage, AND replace all filtration media immediately prior to occupancy (Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999).
- E. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the work even though not specified or indicated.
- F. Training: Provide training in accordance with Section 017900 – DEMONSTRATION AND TRAINING. The Owner reserves the right to retain final payment according to the general conditions of the contract until training is complete.

- G. Inspection: Inspect work preceding or interfacing with work of Division 21/22/23 and report any known or observed defects that affect the Work to the Construction Manager/General Contractor. Do not proceed with the work until defects are corrected.
- H. Existing Utilities: Are indicated as accurately as possible on the Drawings. Close openings and repair damage in acceptable manner to utilities encountered. This Contractor shall be responsible for field surveying all aspects of existing conditions prior to bid date. Change orders will not be issued for a failure to review existing conditions which affect Division 21/22/23 work.

1.2 RELATED WORK

- A. Requirements: Provide Basic Requirements in accordance with the Contract Documents.
- B. Related General Specification Sections:
 - 1. SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS
 - 2. SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION
 - 3. SECTION 017900 - DEMONSTRATION AND TRAINING
 - 4. SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION
 - 5. SECTION 013300 - SUBMITTAL PROCEDURES

1.3 UTILITIES, EXTENSIONS, CONNECTIONS AND FEES FOR WATER AND SEWER

- A. Provide all building services extensions and connections to off-site and on-site utilities.
- B. Sewer connection charges, typically based on fixture units, that in principle allow the right to obtain the sewer services from the utility will be arranged and paid for by the Division 21/22/23 Contractor.
- C. Water system development fees, typically based on meter size, that in principle allow the right to obtain the water services from the utility will be arranged and paid for by the Site Utilities Contractor.
- D. Sewer tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Division 21/22/23 Contractor.
- E. Water tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities Contractor.
- F. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Division 21/22/23 Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the Division 21/22/23 Contractor.

- G. Be responsible for all pads, vaults, manholes, manhole covers, meter enclosures, valves, services boxes, and the like, all in conformance with requirements of the serving utility company.
- H. In the event that the water service to the building is a combination domestic and fire protection service, the responsibility of said "combination service" to the point of domestic connection shall be that of a licensed Fire Protection Contractor, including tap, valves, excavation, backfill, compaction and meters, if any. After point of domestic connection, responsibility for separate fire and domestic services is with appropriate trades including all labor and materials as herein before mentioned.
 - 1. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.
 - 2. Provide fire hydrant, auxiliary gate valve, tapping sleeve and valve or tee, service boxes, and anchor or swivel couplings, thrust blocks, deadmen, rods, and the like, all in conformance with the requirements of serving utility company.

1.4 REFERENCES

A. General:

- 1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- 2. The date of the standard is that in effect as the date of the Contract Documents, except when a specific date is specified.
- 3. When required by individual Specifications section, obtain copy of standard. Maintain copy at job site during work until substantial completion.

B. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

ADC	Air Diffusion Council 1000 E. Woodfield Rd. Schaumburg, IL 60173 www.flexibleduct.org
AGA	American Gas Association 400 No. Capitol St. N.W. Washington, DC 20001 www.aga.org
AMCA	Air Movement and Control Association 30 West University Drive Arlington Heights, IL 60004 www.amca.org

ANSI	American National Standards Institute 1819 L Street N.W. Washington, DC 20036 www.ansi.org
ARI	Air Conditioning and Refrigeration Institute 4301 No. Fairfax Drive. Arlington, VA 22203 www.ari.org
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329 www.ashrae.org
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016 www.asme.org
ASPE	American Society of Plumbing Engineers 8614 W. Catalpa Ave. Chicago, IL 60656 www.aspe.org
ASSE	American Society of Sanitary Engineering 901 Canterbury Westlake, OH 44145 www.asse-plumbing.org
ASTM	American Society for Testing and Materials 100 Barr Harbor Dr. West Conshohocken, PA 19428 www.astm.org
AWS	American Welding Society 550 N.W. LeJeune Rd. Miami, FL 33126 www.aws.org
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235 www.awwa.org

CDA	Copper Development Association 260 Madison Avenue New York, NY 10016 www.copper.org
CISPI	Cast Iron Soil Pipe Institute 5959 Shallow Ford Rd., Suite 419 Chattanooga, TN 37421 www.cispi.org
CS	Commercial Standard of NBS (U.S. Dept. of Commerce, National Institute of Standards and Technology) Government Printing Office Washington, D.C. 20402
CTI	Cooling Technology Institute 530 Wells Fargo Drive Houston, TX 77090 www.cti.org
ICC	International Code Council 5203 Leesburg Pike, Suite 600 Falls Church, VA 22041 www.intlcode.org
IAPMO	International Association of Plumbing and Mechanical Officials 20001 E. Walnut Drive South Walnut, CA 91789 www.iapmo.org
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 www.nebb.org
NEC	National Electric Code (of NFPA)
NEMA	National Electric Manufacturer's Association 1300 N. 17 th Street Rosslyn, VA 22209 www.nema.org
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincey, MA 02269 www.nfpa.org

NSF	NSF International 789 No. Dixboro Rd. Ann Arbor, MI 48113 www.nsf.gov
OSHA	Occupational Safety Health Administration (U.S. Dept. of Labor) Government Printing Office Washington, D.C. 20402 www.osha.gov
PDI	Plumbing and Drainage Institute 45 Brystal Drive South Easton, MA 02375 www.pdionline.org
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association 4201 Lafayette Center Drive Chantilly, VA 20151 www.smacna.org
UL	Underwriters Laboratories, Inc. 333 Pfingston Rd. Northbrook, IL 60062 www.ul.com
USACE	United States Army Corps of Engineers 441 G. Street, NW Washington, DC 20314 www.usace.army.mil

1.5 DEFINITIONS

- A. Specification Language Explanation: These Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the drawings", "a", "the", are intentional. Supply when "NOTE" occurs on Drawings. Supply words "shall be" or "shall" by inference when colon is used with sentences or phrases. Supply words "on the Drawings" by inference when "as indicated" is used with sentences or phrases. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.
- B. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

- C. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.
- D. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.
- E. Indicated: The term "Indicated" is a cross-reference to graphics, notes or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- F. General Contractor: The term "General Contractor" used in Division 21/22/23 and elsewhere in the Contract Documents means the party with whom the Owner has executed the Owner-Contractor Agreement.
- G. Approved Equal: Except as otherwise defined in greater detail, term "approved equal" means that any materials, equipment, work procedures and techniques shall be either addressed on the drawing, specifications or addendum by manufacturer or by detailed material description. When brand names are referenced it implies that only the manufacturers listed are approved. All approved material, equipment, work procedures, and techniques will be noted in the specifications, drawings, or by addendum prior to bid date. Items not approved in this manner will not be considered.

1.6 QUALITY ASSURANCE

- A. Quality Control:
 - 1. Materials and apparatus required for the work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.
 - 2. Furnish the services of an experienced superintendent, who will be constantly in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, certified welders, plumbers, millwrights, sprinkler fitters, drain layers, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate and test for each system.
 - 3. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the manufacturer. This includes the performance of tests as recommended by the manufacturer.
- B. Proof of Performance:

1. Division 21/22/23 Contractor shall provide proof of performance certification of all Mechanical Equipment and Systems to demonstrate that all Mechanical Equipment and Systems are operating to the intent of the design. This proof of performance shall include, but shall not be limited to, actual demonstration of all temperature/pressure control loops, operation of all heating/cooling equipment and other required tests upon request by the Engineer or Owner. A signed certificate from the piping, sheet metal, control, and balancing subcontractors stating that they have personally checked the operation of all equipment and control loops and that everything under their subcontract is operating as specified. These certificates shall be furnished to the 230593 Contractor for inclusion in the Operation and Maintenance Manual.
- C. All system components, controllers, host computers, portable terminals, and similar equipment, all hardware and software (including third party products) furnished by this contractor shall conform to the following:
1. General Integrity: No value for current date (minimum range from 1980 to 2036) will cause any interruption in operation.
 2. Date Integrity: Date-based functions shall behave consistently for dates prior to, during, and after Year 2000 (minimum range from 1980 to 2036).
 3. Explicit/Implicit Century: The century in any date shall be specified either explicitly or by unambiguous algorithms or inferencing functions.

1.7 REGULATORY REQUIREMENTS

- A. Execute work per Underwriters, Public Utility, Local and State Codes, Ordinances and applicable regulations. Obtain and pay for required permits, inspections, and certificates. Notify Architect of items not meeting said requirements.
- B. Comply with editions of all applicable codes, ordinances and regulations in effect at the time of bid opening including but not necessarily limited to the following:

International Mechanical Code
International Plumbing Code
International Fuel Gas Code
State Department of Health Requirements
State Energy Code
National Fire Protection Association Standards
International Fire Code
International Building Code
National Electrical Code NFPA-70
State Boiler Code
Jurisdictional County Health Department
Jurisdictional City Wastewater Management Division or District
Jurisdictional City Water Department
Jurisdictional Water Conservation Standards

- C. If discrepancies occur between the Contract Documents and any applicable codes, ordinances, acts, or standards, the most stringent requirements shall apply.
- D. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the IBC, and listed by Underwriters Laboratories, Inc.

1.8 SUBMITTALS

- A. Contractors are required to submit Mechanical Cost Breakdown to Engineer when submitting shop drawings. Shop drawings will not be accepted without a complete Mechanical Cost Breakdown. See last page of this Section for requested breakdown. If your standard compilation of bids is different than our requested breakdown, please send it in your format. We need the data to keep our cost estimating files up to date. Just fill-in blanks with a pencil, typing is not required.
- B. Submit Samples, Shop Drawings and Product Data as required by various Sections of Division 21/22/23 in accordance with The General Conditions of the Contract. The Contractor agrees that these Submittals processed by the Engineer are not Change Orders; that the purpose of these Submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. Contractor further agrees that if deviations, discrepancies, or conflicts between these Submittals and the Contract Documents in the form of design drawings and specifications are discovered either prior to or after these Submittals are processed by the Engineer, the Design Drawings and Specifications shall control and shall be followed.
- C. The submittals shall be submitted in a single package with all mechanical equipment for the project enclosed. The submittals shall be enclosed in a stiff back, 3-ring binder. All mechanical equipment shall be separated with tabbed index cards with an indexed legend provided in the front of the binder.
- D. Test Reports: Submit certified test reports as required by various Sections of Division 21/22/23 showing compliance in accordance with General Conditions of the Contract. Signed copies shall be included in the Operation and Maintenance Manual.
- E. Operating Instructions and Maintenance Data: Prepare and submit printed operating instructions and maintenance data in accordance with Operating and Maintenance Data paragraph in this Section.
- F. Submittals will be reviewed and marked as follows:
 - 1. Approved: No action required. Submittals are accepted as submitted.
 - 2. Approved as Noted: Correct the submittals per notes by engineer and submit new copies of submittal to contractor for project records. Do not resubmit to Engineer.
 - 3. Revise as Noted: Correct the submittals per notes by engineer and resubmit to Engineer for approval.

- 4. Rejected: Equipment as submitted does not meet requirements of contract documents. Revise and/or clarify per comments and resubmit to Engineer.
 - 5. Submittal not Requested: Submittal not required per specification. Submittal returned with no review.
- G. Note that Engineer's approval does not relieve Contractor from being ultimately responsible for ensuring that submitted items satisfy all requirements of the Contract Documents.

1.9 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Substitutions and Prior Approvals: Substitutions and prior approvals will be acceptable only when the proposed substitute has been submitted to the Engineer and approved through an addendum or change order. Request for prior approval shall be submitted a minimum of 10 calendar days prior to bid.
- B. Some materials and equipment are specified by manufacturer and catalog numbers. The manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.
- C. NOTE: When alternate or substitute materials and equipment are used Division 21/22/23 Contractor shall be responsible for engineering/redesign costs, space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use. Notification of General Contractor and other affected subcontractors shall be the responsibility of the Division 21/22/23 Contractor.

1.10 PROJECT RECORD DOCUMENTS

- A. General: Comply with Division 1.
- B. Job Site Documents: Maintain at the job site, one record copy of the following:
 - 1. Drawings
 - 2. Specifications
 - 3. Addenda
 - 4. Reviewed Shop Drawings
 - 5. Field Test Records

Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.

- C. Record Information: Label each document "Record Document". Mark information with red ink. Keep each record current. Do not permanently conceal any work until required information is recorded.
- D. Record following information on Drawings:

1. Horizontal and vertical location of underground utilities to be dimensioned from column lines.
 2. Dimensioned location of internal utilities and appurtenances concealed in construction.
 3. Field changes of dimension and detail.
 4. Changes by change order or field order.
 5. Details not on original contract drawings.
 6. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed shall be indicated on equipment schedules.
- E. Record the following information on Specifications:
1. Changes by change order or field order.
 2. Other matters not originally specified.
- F. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.
- G. Submittal: At completion of project, deliver record documents to Owner's representative and transmit a copy of signed receipt from Owner to the Engineer.

1.11 OPERATING AND MAINTENANCE DATA

- A. Division 21/22/23 Contractor shall submit five (5) typed and bound copies of the maintenance manual, 8-1/2" x 11" in size, to the Mechanical Consulting Engineer for approval. These approved copies will be returned to the Contractor and shall then be transmitted to the Owner.
- B. Organization of the manuals shall follow the recommendations in ASHRAE Guideline 4-1993.
- C. The manual shall be enclosed in a stiff-back, three-ring binder and shall have:
1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
 2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown. Note that these instructions are for entire systems. Simply providing manufacturer's shutdown procedures for individual components is unacceptable.
 3. Maintenance instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules.
 4. All test reports and proof of performance certificates.
 5. Manufacturer's data on each piece of equipment, including the following. Provide original printed material in each book, faxes and photocopies are NOT acceptable.

- a. Installation instructions.
 - b. Drawings and specifications (final shop drawings).
 - c. Parts lists.
 - d. Complete "as-built" wiring and temperature control diagrams. (Shop drawings are not acceptable.)
 - e. Lubrication and other preventative maintenance data.
 - f. Equipment warranties.
- D. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified on drawings. Insert a copy of the Equipment List or Equipment Schedules in manual.
 - 1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches. Label with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
 - 2. Tag all manual operating valves per requirements in Section 230529.
 - 3. Provide a typed tag list or schedule laminated or mounted under plexiglass in the equipment room stating number, location, and function of each tagged item. Insert a copy of tag list in each "Maintenance Manual".
 - 4. Provide a reduced scale drawing of each floor indicating the location of each manual and automatic valve in every HVAC and plumbing piping system and include valve position number and normal valve position (normally open/normally closed) as per Specification Section 230529. Mount all drawings under plexiglass or laminate and mount on equipment room wall.
- E. Division 230593 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the maintenance manual as a guide. These meetings must be scheduled through the Architect, Construction Manager/General Contractor and far enough in advance so that all necessary personnel can be adequately notified.
 - 1. Submit training certificate to Owner's Representatives at end of training and have certificate signed by Owner's Representative to indicate adequate training has been received.

1.12 OPERATING AND MAINTENANCE MANUALS

- A. The "Operating and Maintenance Manual" (O & M) is a bound compilation of descriptive drawings and data which identify equipment installed at the project site and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment items.
- B. Three sets will be required for each project. These are to be submitted for approval to the Project Manager.
- C. All data and instruction sheets shall be marked to indicate the plan symbol, model, number, and options installed for each item of equipment furnished and installed. These

data sheets shall either be reviewed and approved submittals or shall be accompanied by such.

- D. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.
- E. Pages are to be standard 8-1/2" x 11" sheets, or 11" x 17" folded to fit the 8-1/2" x 11" sizes.
- F. Additionally, the following information is to be included:
 - 1. A complete parts list(s) and source of supply for each piece of equipment, marked with model, size, and plan symbol.
 - 2. A copy of the approved submittals for each piece of equipment.
 - 3. The balance report.
 - 4. Performance curves and capacity data, marked with model & size and plan symbol.
 - 5. Wiring diagrams, marked with model and size and plan symbol.
- G. Enclose the material in rigid 3-ring binders and submit to the Project Manager at the completion of the project. Binders shall be Buckram binders or prior approved equal with block lettering. Sheet size shall be 8-1/2" x 11" with expandable metal capacity as required for the project. The number of binders forming one O & M Manual shall be based on a maximum limit of 4 inches.
- H. The following information shall appear on the front cover and backbone:
 - 1. "Operation and Maintenance Manual"
 - 2. Project Name (and volume number if more than one volume)
 - 3. Owner Project number
 - 4. Building name, number, and street address
 - 5. * Architect's name
 - 6. * Engineer's name
 - 7. * General Contractor's name
 - 8. * Mechanical Contractor's name

* Items "6" through "8" need not be printed on the backbone.
- I. Include a Table of Contents and tabbed index dividers.

1.13 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver and store materials and equipment in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.
- B. Protection: Store materials and equipment off the ground and under cover, protected from damage. Maintain caution labels on hazardous materials.

- C. Large Items: Make arrangements with other contractors on the job for introduction into the building of equipment too large to pass through finished openings.

- D. Handling of Materials: Materials shall be handled, sorted and distributed using appropriate handling methods to protect all materials from damage. Dented, rusted, corroded or otherwise damaged materials shall be removed from the project site. Determination of materials deemed unusable or inappropriate for installation shall be made by the Architect/Engineer.

1.14 PROJECT CONDITIONS

A. Accessibility:

1. Division 21/22/23 Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of his work. He shall cooperate with Contractors of other Divisions of the Work whose work is in the same space and shall advise the Construction Manager/General Contractor of his requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
2. Division 21/22/23 Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include (but not be limited to) valves, shock absorbers, traps, cleanouts, motors, controllers, switchgear, filters, VAV boxes, control valves, balancing valves, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the Architect/Construction Manager/General Contractor prior to making the change.
3. Division 21/22/23 Contractor shall provide the Construction Manager/General Contractor with the exact locations of access doors for each concealed valve, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.

B. Fabrication:

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

C. Freeze Protection:

1. Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.

D. Scaffolding, Rigging and Hoisting:

1. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required.

1.15 COORDINATION

- A. General: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.
- B. Coordination with Electrical Work: Section 230529.
- C. Utility Interruptions: Coordinate mechanical utility interruptions with the Owner and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.
- D. Cutting and Patching: Section 230529.
- E. Drawings and Specifications: The Mechanical Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown is diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Take dimensions, measurements, locations, levels, etc., from the Architectural Drawings and equipment to be furnished.
- F. Each Division 21/22/23 subcontractor shall coordinate with other contractors to make certain that any of his equipment, piping or ductwork which is mounted on isolators or flexibly connected does not become "grounded" by another contractors work (e.g. walls, ceiling, etc.).
- G. Discrepancies: Examine Drawings and Specifications for other parts of the work, and if any discrepancies occur between the plans for the work of this Division and the plans for the work of others, report such discrepancies to the Construction Manager/General Contractor and obtain written instructions for any changes necessary.
- H. Order of Precedence: The precedence of mechanical construction documents are as follows:
 - 1. Addenda and modifications to the Drawings and Specifications take precedence over the original Drawings and Specifications.
 - 2. Should there be a conflict within the Specifications or within Drawings of the same scale, the more stringent or higher quality requirements shall apply.
 - 3. In the Drawings, the precedence shall be Drawings of larger scale over those of smaller scale, figured dimensions over scaled dimensions and noted materials over graphic indications.
 - 4. Should there be a conflict in dimensions or locations between Mechanical Drawings and Architectural Drawings, the Architectural Drawings shall have precedence.

1.16 START-UP PROCEDURES

- A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition which may cause damage to equipment or endanger personnel.
- B. Insure that all control systems are fully operational in automatic mode. Individually test each control loop to make certain it is operating as intended and is communicating properly with other devices.
- C. If systems are not to continue in use following the start-up procedures, steps should be taken to insure against accidental operation or operation by unauthorized personnel. Provide padlocks on disconnect switches where applicable.
- D. Factory personnel shall be notified as appropriate to start systems requiring their services.
- E. Notify engineer at least 2 weeks prior to the scheduled start-up date of all major mechanical equipment and systems.

1.17 SCHEDULE OF TESTING

- A. Provide testing in accordance with the General Conditions of the Contract.
- B. A schedule of testing shall be drawn up by the Division 21/22/23 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.
- C. All testing must be performed in the presence of the Architect's/Construction Manager's/General Contractor's representative; his signature for verification of the test must appear on the schedule.
- D. All testing must be performed in accord with the procedures set forth in Division 21/22/23 and other Sections of the Specifications where referenced. At completion of testing, the completed schedule shall then be submitted in triplicate to the Architect and a copy shall be forwarded to the 230593 Contractor for inclusion in Operation and Maintenance Manual.
- E. Make all specified tests on piping, ductwork and related systems as specified in this specification.
- F. Make sure operational and performance tests are made on seasonal equipment.
- G. Complete all tests required by Code Authorities, such as smoke detection, life safety, fire protection and health codes.

- H. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, settings on pressure relief valves properly adjusted, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

1.18 CLEANING AND FINISHING

- A. Provide cleaning in accordance with the General Conditions of the Contract and Division 1.
- B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 21/22/23 of the work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.
- C. Section 232113 Contractor shall be responsible to certify that all HVAC Piping Systems have been cleaned in accordance with Section 232500 - HVAC Water Treatment whether actually done by the Section 232113 Contractor or by the 232500 Contractor.

1.19 WARRANTIES

- A. Warranty: Provide a written warranty to the Owner covering the entire mechanical work to be free from defective materials, equipment and workmanship for a period of one year after Date of Acceptance. During this period provide labor and materials as required to repair or replace defects. Provide certificates for such items of equipment which have warranties in excess of one year. Submit to the Construction Manager/General Contractor for delivery to the Architect. Include a copy of all warranties in the Operation and Maintenance Manual.
- B. This warranty will be superseded by the terms of any specific equipment warranties or warranty modifications resulting from use of equipment for construction heat or ventilation.
- C. All refrigeration compressors shall have a (4) four year extended warranty from the manufacturer of the equipment in addition to the standard one-year warranty.

1.20 PROJECT CLOSEOUT

- A. Project Observation Reports:

At or near the completion of the construction phase of this project, the Engineer will generate one or more Project Observation Reports for the owner. These reports will list the items of construction observed by the Engineer which are not in compliance with the Contract Documents.

The Mechanical Contractor and/or subcontractors shall certify completion of each listed item in writing and forward copies to the Architect, Engineer and General Contractor. The Engineer will not recommend the payment of retainage until this compliance certification has been received.

Each item on the Project Observation Report shall have a signature/date in the margin of the report indicating completion of that item.

1.21 CERTIFICATES AND KEYS

- A. Certificates: Upon completion of the work, deliver to the Construction Manager/General Contractor one copy of Certificate of Final Inspection.
- B. Keys: Upon completion of work, submit keys for mechanical equipment, panels, etc. to the Construction Manager/General Contractor.

1.22 UNIT PRICES

- A. Refer to Section 012200 - Unit Prices where scope and description of unit prices are given.

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END OF SECTION 230500

CONFIDENTIAL

(For CEA Use Only)

MECHANICAL COST BREAKDOWN (Rounding off to the nearest \$500 is acceptable)

PROJECT NAME: UNG – NSL Readiness Center

BID DATE: (month/year) _____ CEA PROJECT NO.: 2006-095.00

SUBCONTRACTOR NAME: _____

HVAC Equipment:	\$
HVAC Piping Material and Labor:	\$
Sheet Metal Equipment:	\$
Sheet Metal Material and Labor:	\$
Insulation:	\$
Plumbing Equipment and Fixtures:	\$
Plumbing Piping Materials and Labor:	\$
Automatic Temperature Control:	\$
Testing, Adjusting and Balancing:	\$
Fire Protection:	\$
*Medical Gases:	\$
*Medical Gas Certification:	\$
*Clean Room Certification:	\$
*Process Piping Materials and Labor:	\$
*Site Utilities Piping:	\$

A completed copy of this form MUST be forwarded to the Engineer before any shop drawings/submittal will be reviewed. See Section 230500, 1.8, A.

Fax or mail completed form to:

Colvin Engineering Associates, Inc.
244 West 300 North, Suite 200
Salt Lake City, Utah 84103
(801) 322-2400 - Phone
(801) 322-2416 – Fax

SECTION 230529 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Work furnished but not installed by this Contractor:
 - 1. Access doors in accordance with paragraph 2.3 in this Section 230529.

1.2 SYSTEM DESCRIPTION

- A. The work includes, but is not limited to the following:

Materials and methods common to the work in general of Division 23 and other Divisions and Sections of the Specifications where referenced.

1.3 QUALITY ASSURANCE

- A. Welder Qualifications:
 - 1. Each welder shall have passed a qualification test within the past 6 months.
 - 2. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications", ASME Section VIII, and ANSI 313.
 - 3. The test report shall certify that the welder is qualified to weld the material to be used at the job site.
 - 4. The Contractor shall submit three copies of each welder's qualification test report to the Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified.

1.4 REFERENCES

- A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
 - 1. For electrical equipment and products, comply with applicable National Electrical Manufacturers Association (NEMA) Standards, and refer to NEMA Standards for definitions of terminology herein.

2. Comply with National Electrical Code (NEC) NFPA-70 for electrical installation requirements.
3. Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, & B31.9 as applicable for welding requirements.
4. Comply with American National Standards Institute (ANSI A13) for identification of piping systems.
5. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.
6. State of Utah, Division of Facilities Construction and Management Design Criteria.

1.5 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:
 1. Legend and color of piping and equipment identification <per University of Utah Campus Design and Construction Standards>.
 2. Freeze Protection Systems for Piping and Equipment (Heat Tracing).
 3. Domestic Hot Water Heat Maintenance System.
- B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data Paragraph in Section 230500.
 1. Motors.
 2. Starters.
- C. Certificates: Before proceeding with the Work, submit to the Architect/Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with the Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.

PART 2 - PRODUCTS

2.1 MOTORS

- A. General: Furnish motors necessary to operate mechanical equipment.
- B. Motor Characteristics: Comply with the following requirements:
 1. Variable Speed Drive Compatibility: All motors which are powered through a variable frequency drive shall conform to NEMA MG-1, Part 31 for inverter duty and shall be capable of continuous operation at 20% of nominal speed and shall

- meet the requirements of the Variable Frequency Drive specification in Section 230810 or Division 26 as applicable.
2. Altitude Deration: Motors to be furnished to maintain specified rated service factor at altitude of project.
 3. NEMA Temperature Rating: Rated for 40 deg.C environment for continuous duty at full load, Class B motor temperature rise. Motors for use with variable frequency drives shall be Class F Insulated.
 4. Starting Capability: Provide each motor capable of making starts as frequently as indicated by the automatic control system.
 5. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 3/4 horsepower and larger, and provide capacitor-start single-phase motors for 1/2 horsepower and smaller. One-sixth horsepower and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 and with individual equipment requirements specified in other Sections of Division 21/22/23. Provide two separate windings on polyphase two speed motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
 6. Power Factor: All motors rated greater than 1000 watts shall have a Power Factor of not less than 85% under rated load conditions. The 85% PF may be obtained by design of the motor or by providing a capacitor. Capacitors, if provided to obtain the 85% PF, must be switched with the motor. If the motor draws less than 1000 watts at full load, it is excluded from the 85% power factor requirement.
 7. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors. Motors shall be selected such that the brake horsepower requirement is not within the service factor at design load.
 8. Efficiency: All motors shall be premium energy efficient type in accordance with the current State Energy Code, except where a higher efficiency is noted on drawings.
 9. Motor Construction: Provide Design "B" motors for general purpose continuous duty and Design "C" motors where required for high starting torque such as the low speed motor on fans with a two-motor drive arrangement. Small motors that are part of packaged equipment may be manufacturer's standard motors meeting Energy Code requirements for efficiency.
 - a. Bearings: Ball or roller bearings with inner and outer shaft seals: regreasable; except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in the motor, provide bearings designed to resist the thrust loading. Refer to individual sections of Division 21/22/23 for fractional horsepower light-duty motorized equipment where sleeve-type bearings are permitted.
 - b. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual Sections of Division 21/22/23 for other enclosure requirements.

- c. Overload Protection: Provide built-in thermal overload protection for each leg of each phase and, where indicated, provide internal sensing device suitable for signaling and stopping the motor at the starter. Thermal overload protectors shall be sized to accommodate the altitude of installation.
- d. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, NEMA efficiency, power factor, special features and similar information.
- e. Motor Connections: Provide conduit connection boxes.
- f. Motors shall not exceed 80dbA rating when running their full speed and power range.

2.2 STARTERS

- A. Note that some starters are furnished and installed under Division 26. Review Electrical Plans before bidding.
- B. General: Furnish starters and contactors necessary to operate mechanical equipment motors. **Starter manufacturer shall be the same brand for ALL motors furnished under Division 21/22/23.** Approved manufacturers shall be those listed in Division 26 or this specification.
- C. Motor Starter Characteristics: Comply with NEMA standards and NEC. Furnish Type I general purpose enclosures with padlock ears, and with frames and supports for mounting on wall, floor or panel as required. Furnish the type and size of starter recommended by the motor manufacturer and equipment manufacturer for the applicable protection and start-up condition; refer to individual equipment sections for basic load requirements. All starters shall be by the same manufacturer. Only manufacturers approved by Division 26000 will be accepted. All starters shall comply with Division 26000 requirements.
- D. Manual Control:
 - 1. Furnish maintained-contact push buttons and pilot lights, properly arranged for single-speed or multi-speed operation as indicated.
 - 2. Furnish manual switch and pilot light for motors 1/3 horsepower and smaller, except where interlock or automatic operation is indicated.
- E. Automatic Control:
 - 1. Furnish magnetic starters for motors 1/2 horsepower and larger and for smaller motors where interlock or automatic operation is indicated. Include the following:
 - a. Maximum number of auxiliary contacts available: three or more.
 - b. "Hand-Off-Automatic" switches in starter cover.
 - c. Interlocks, pneumatic switches and similar devices as required for coordination with the control requirement specified in Section 230900-Electronic Controls.

- d. Built-in 120 volt control circuit transformer, fused from line side, where service exceeds 240 volts.
 - 1) Control circuit conductors to be protected in accord with the National Electrical Code.
 - e. Trip-free thermal overload relays, each phase.
 - f. Externally operated manual reset except on refrigeration compressors which shall have automatic reset. Automatic reset shall be limited to three attempts. If motor fails to start after three attempts, manual reset shall be required.
 - g. Undervoltage release or protection.
 - h. Phase failure/phase reversal protection on all legs.
- F. Weather Protection: Provide weather-proof mounting of magnetic starters for equipment outside of the building.

2.3 ACCESS DOORS

- A. Furnish steel access doors, minimum size required for normal service use or as sized on drawings as specified in Division 8, where shown on mechanical or architectural drawings, and where required for access to valves, shock absorbers, dampers, mechanical equipment or appurtenances.
- D. Exact location of access doors shall be as directed by Mechanical Contractor and approved by the Architect.
- E. Doors shall be installed by the General Contractor.

2.4 VALVES

- A. General:
 - 1. Provide valves as specified herein and as indicated on the Drawings complete with accessories and attachments as required and appropriate for the pressure/temperature of system.
 - 2. Supply valves for proper pressure ratings determined by the system working pressures at point of use and of proper types for systems and functions indicated.
 - 3. Steam and Condensate System Isolation Valves: Use steam rated ball valves on pipe sizes 2" and smaller. Use gate valves on pipes larger than 2". Use globe valves on manual bypass lines.
 - 4. Provide like type valves of one manufacturer only unless specified otherwise.
 - 5. Plainly and permanently mark valves with manufacturer's name or trademark, pressure rating, both Cold Working Pressure (CWP) and Steam Working Pressure (SWP), as applicable and flow direction when required to prevent improper installation.

6. Mark valves requiring approval by Underwriter's Laboratories (UL) or Factory Mutual Engineering Division (FM) with appropriate markings cast into the valve body.
7. Provide extended necks as appropriate for insulation.

B. Manufacturers:

1. The following manufacturers are acceptable providing the product to be considered is equivalent in every respect to the nomenclature provided by the specified make and model.
 - a. Bronze Valves: Hammond, Powell, Milwaukee, Walworth, Crane, Nibco.
 - b. Iron Body Valves: Hammond, Powell, Milwaukee, Traverse City, Kennedy, Iowa, American, Nibco.
 - c. U.L., F.M. Approved or Listed Valves: Hammond, Milwaukee, Nibco, Demco, Pratt, Kennedy, Mission.
 - d. Ball Valves: Hammond, Nibco, Watts, Jamesbury, Worcester, Milwaukee, Apollo, Powell, Dynaquip, Spirax Sarco.
 - e. Butterfly Valves: Milwaukee, Hammond, Centerline, DeZurik, Fisher, Victaulic, Keystone, Posi-Seal, TEC, Flowseal, Nibco.
 - f. Lubricated Plug Valves: Homestead, Nordstrom, Powell, Walworth.
 - g. Non-Lubricated Eccentric Plug Valves: DeZurik.
 - h. Stop and Drain and Drain Valves: Milwaukee, Hammond, Prier, Nibco or United Brass.
 - i. Gas Cock: Peter Healy or Crane.

C. Valve Schedule:

1. Standard Bronze Valves - 150 SWP/300 CWP, per ASTM B61/62. No brass materials will be accepted.
 - a. Check, Gate, and globe with union bonnet and rising stem.
 - b. Sizes 1/8 through 2 inches.
 - c. Schedule:

Plan Code:	G.V.	GL.V.	C.V.	L.C.V.
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-134	T-235Y	T-433Y	365.5
Straight Soldered:	S-134	S-235Y	S-433Y	--
Angle Threaded:	--	T-335Y	--	--
Angle Soldered:	--	--	--	--

2. Standard Bronze Valves - 300 SWP/600 CWP, per ASTM B61/B62, no brass materials will be accepted.

- a. Gate, globe and check.
- b. Sizes 1/8 through 2 inches.
- c. Schedule:

Plan Code	G.V.	GL.V.	C.V.	L.C.V.
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-134	T-235Y	T-433Y	365.5
Straight Soldered:	S-134	S-235Y	S-433Y	--
Angle Threaded:	--	T-335Y	--	--
Angle Soldered:	--	--	--	--

3. Standard Iron Body Valves - 125 SWP/200 CWP.

- a. Gate, globe and check.
- b. Sizes 2-1/2 through 12 inches.
- c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	W.C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Weighted	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-619	T-617-0	T-718B	T-918Y	T-918YBLW	--
Straight Flanged:	F-619	F-617-0	F-718B	F-918Y	F-918YBLW	23
Angle Threaded:	----	----	T-818B		----	----
Angle Threaded:	----	----	F-818B	----	----	----

4. Standard Iron Body Valves - 150 SWP/300 CWP.

- a. Gate, globe and check.
- b. Sizes 2 through 12 inches.
- c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Crane (Chapman)
Straight Threaded:	T-669	T-667-0	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	--

5. Standard Iron Body Valves - 250 SWP/500 CWP.

- a. Gate, globe and check.
- b. Sizes 2 through 12 inches.
- c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-669	T-667-0	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	--

6. UL and FM Approved Valves.

- a. Gate, check and butterfly.
- b. Sizes all.
- c. Schedule:

Plan Code:	OS&Y	C.V.	W.V.C.	BF.V	D.V.
Valve Type:	Gate	Swing	Wafer	BTFY	Drain
Make:	Nibco	Nibco	Nibco	Demco	Nibco
Straight Threaded:	T-104-0	T-413W	--	--	T-211Y
Straight Flanged:	F-607-0	F-908-W	--	--	--
Wafer:	--	--	W-900-W	NE-H	--

7. UL and FM Approved Valves - 175 Pound Water.

- a. Post indicator with indicator post.
- b. Sizes 4 through 12 inches.

c. Schedule:

Plan Code:	P.I.V.	P.I.V.B.F.
Valve Type:	Gate	BTFY
Make:	Nibco	Demco
Straight Flanged:	F-609	NE-H (Wafer)
Mechanical Joint:	M-609	--
Indicator Post Vertical:	NIP-1	Stem extension and gear operator with post indicator U.L. Listed only.
Indicator Post through Wall:	NIP-2	--

8. Underground Valves - 175 Pound Water, American Water Works Association (AWWA).

- a. Gate valves with service boxes.
- b. Sizes (see schedule).
- c. Schedule:

Plan Code:	GV & SB	GV & SB
Size/Inches:	3/4 thru 2	2 thru 16
Valve Type:	Oriseal	Gate
Make:	Mueller	Mueller
Model:	H-15201	A-2380-22 or 2380-18
Service Box:	H-10396-86	H-10357
Base:	H-10396-7-8-9 or H-10400	No. 6 Oval
Key:	Stationary rod attached.	A-24610 Furnish one each box.

9. Ball Valve:

- a. Blowout proof stem.
- b. Ball port type with appropriate seals and seat, as specified.
- c. Bronze bodies per ASTM B61/B62 or ASTM B-584, no brass material will be accepted.
- d. Stainless steel bodies per ASTM A-351, Grade CF3M.

e. Schedule:

Plan Code:	B.V.	B.V.	H.V.	S.B.V.
Service:	Balancing	In line control and isolation	Refrigeration	Steam and Steam Condensate
Pressure:	150 SWP/300 CWP	150 SWP/300 CWP	500 CWP	150 SWP
Sizes/Inches:	1/4 thru 2-1/2	1/4 thru 3"	3/8" thru 2 1/8"	1/2" thru 2"
Make:	Nibco	Nibco	Nibco	Nibco
Straight Threaded:	T-585-70-66	T-585-70-66	--	T595-Y-S6R-66
Straight Solder End:	S580-70	S585-70	S595-Y-66	--
Actuator:	Lever with memory stop	Lever	Lever	Lever
Port:	Standard	Full	Full	Full

*Steam ball valve includes a three-piece body, seals rated for steam operating temperatures up to 400°F.

10. Butterfly Valves:

- a. Schedule; standard 150 psi with 150 psi ANSI companion flanges for use where system pressures cannot exceed 200 psig shut off (static) pressure.

Plan Code:	BFV		
Style:	Semi-lug wafer body		
Pressure Rating ANSI Class:	150 minimum		
Body:	Cast Iron		
Disc:	Aluminum Bronze		
Stem:	416 stainless steel		
Seat:	EPDM (-40 deg.F to 250 deg.F)		
Actuator:	2" thru 5" Infinite position lever with memory stop. 6" thru 20" Self-locking worm gear with adjustable limit stops, and position indicator. Provide chain wheel and chain where indicated by contract documents.		
Make:	Keystone		
Size:	2"-12"	14"-20"	
Model:	228	122	

- b. Schedule: High performance 300 psi with 300 psi ANSI companion flanges for use where system pressures are more than 200 psig but cannot exceed 700 psig shut-off (static) pressure.

Plan Code:	BFV
Style:	Lug
Pressure Rating ANSI Class:	300 minimum
Body:	Carbon steel ASTM A-216
Disc:	316 stainless steel ASTM A-216
Stem:	Stainless steel ASTM A564 Type 630 (17-4PH)
Seat:	Virgin TFE
Actuator:	3" and 4": Ratchet handle with lock. 6 and over: Worm gear with lock.
Make:	Flowseal (Mark Controls Corp.)
Size:	3" and 4" 6" and over
Model:	XX-3L-121TTH-L XX-3L-121TTH-2

11. Stop Check Valve:

- a. Schedule:

Plan Code:	S.C.V.
Pressure:	250 SWP/500 CWP
Size/Inches:	2-1/2 thru 10"
Make:	Crane
Straight Flanged:	28E
Angle Flanged:	30E

12. Eccentric Plug Valve:

a. Schedule:

Plan Code:	E.P.V.	E.P.V.
Pressure:	175 lb. CWP	175 lb. CWP
Size/Inches:	1/2 thru 3	4 thru 8
Make:	DeZurik	DeZurik
Model:	400	100
Actuator:	483-487	159 w/Memory Stop
Ends:	Threaded	Flanged

13. Gas Valves:

a. Gas cock and lubricated plug.

b. Schedule:

Plan Code:	G.C.K.	L.P.V.	L.P.V.	G.B.V.
Pressure:	100 PSI Air	200 lb. CWP	200 lb. CWP	250 PSI LP-Gas
Size/Inches:	1/2 thru 1	1/2 thru 3	4 thru 12	1/4" thru 3"
Make:	Peter Healy	Walworth	Walworth	Apollo
Model:	1500-F	1700	1707-F	80-100
Actuator:	None	E-2	Wrench as required	1/4 turn
Ends:	Threaded	Threaded	Flanged	Threaded

14. Specialty Valves:

a. Petcock, stop and drain, drain, needle.

b. Schedule:

Plan Code:	PTK	S&D.V.	D.V.	N.V.
Type:	Petcock	Gate	Ball	Needle
Pressure:	250 LB.	125 LB.	125 LB.	200 LB.
Size/Inches:	1/8	1/2 and 3/4	3/4	1/8 thru 3/4
Make:	Powell	Nibco	Apollo	Jenkins
Model:	922	76 or 726	78-104	743G
Ends:	Threaded	Threaded or Soldered	Threaded and Hose End Adaptor	Threaded

2.5 PIPE HANGERS, SUPPORTS, AND ACCESSORIES PROTECTION

A. General:

1. Provide hangers, rods, clamps, brackets, attachments, inserts, bracing, nuts, coach screws, eye bolts, clips, plates, and washers as required for appropriate installation for building structure provided.
2. All hangers and accessories shall be manufactured by one manufacturer for compatibility of all components.
3. All hangers, attachments, and accessories shall be provided with a certified manufacturers safety factor of five (5).
4. All hangers, attachments and accessories shall comply with the following:
 - a. Safety factor of 5 (actual load vs. ultimate load).
 - b. National Fire Protection Association (NFPA) (except as amended by provisions of this Specification for minimums) and as applicable.
 - c. Factory Mutual Engineering Division (FM) as applicable.
 - d. Manufacturers Standardization Society (MSS).

B. Material:

1. Hangers in contact with steel, iron, cast or ductile iron shall be hot dipped galvanized or cold galvanized with "ZRC" cold galvanized compound only to a thickness of not less than 3.0 mil (.003 inches). "ZRC" cold galvanizing compound is manufactured by ZRC Chemical Products Co., Quincy Mass.
2. Hangers in contact with copper piping shall be copper clad or provided with heavy density felt (20 oz.) pad permanently attached to the hanger and placed so as to prevent direct contact between pipe and hanger. Felt shall be mildew and moisture rot proof. Heavy polyvinyl chloride coating on hanger, 5 mil thickness minimum will be acceptable in lieu of felt.
3. Hangers in contact with "plastic" or "glass" piping shall be galvanized in accordance with Sub-paragraph B-1, above and padded in accordance with Sub-paragraph B-2, above.
4. Hangers for insulated piping shall be provided on all piping of this size with insulation shields or insulation saddles* as applicable and appropriate and in accordance with the following schedule:

Nominal Pipe or Tubing Size	Shield Length	Shield Gauge Thickness	Material
1/2" thru 3"	12"	18	galvanized
4"	12"	16	galvanized

* Insulation inserts between piping and shield shall be furnished by 230700 Contractor for appropriate pipe size and insulation thickness for all insulated piping requiring a vapor barrier.

5. Provide swivel ring hangers similar and equivalent to B-Line B-3170, 3170CT, and 3170C for pipe sizes 1/2" thru 8".

6. Clevis type hangers may, at the Contractors option, be provided when similar and equivalent to B-Line B-3100, and 3100C.
7. Roller type hangers shall be used on all steam piping 4" and larger and when appropriate shall be equivalent to B-Line B-3110 black steel with cast iron roller. Provide insulation saddles for all roll-type hangers, B-Line B3160-3165. Calcium silicate inserts, in conjunction with insulation saddles shall be provided on all steam piping.
8. Beam and bar joist clamps shall be appropriate for attachment locations, top beam, bottom beam, etc., and provided with retainer rods, clips or straps as required.
9. Hanger spacing and minimum rod sizes in the following schedule are based on combined bending and shear stress of 1500 psi when the pipe is filled with water and 1/10-inch deflection allowance between supports, all valves, heavy fittings and changes in direction of piping shall be additionally supported with hangers each side of valves and heavy fittings, and one additional support within one foot of the directional change. Where more stringent hanger spacing and rod sizes are required by jurisdictional authority, the more stringent requirements shall supercede the following schedule.

Nominal Pipe or Tubing Size	Maximum Support Spacing Center to Center (ft)	Minimum ATR or MTR rod dia (in)
½" thru 1"	6	3/8"
1-1/4" thru 2"	7	3/8"
2-1/2" thru 3"	10	1/2"
4"	14	5/8"

10. Riser clamps shall be provided on all vertical risers at each floor and shall conform to materials and protective coatings or pads as specified in Paragraph B of this Article 2.05. Clamps shall be similar and equivalent to B-Line B-3131 and B-3148.
11. Provide concrete inserts where required in flat slab construction similar and equivalent to B-Line B-22-1 Series 2000 lbs. per foot load capacity and spaced per hanger spacing schedule (sub-paragraph B-9 above) provide all accessories and nuts required.
12. Trapeze hangers shall be constructed of channel similar and equivalent to B-Line Series B-11 thru B-72 as appropriate complete with pipe clamps, nuts, rollers etc., as required. Channel to bear 5 times actual weight of all piping on trapeze system with minimum deflection. (.01 inch maximum).
13. Wall brackets shall be fabricated "knee" brackets conforming to requirements of sub-paragraph B-12 above and made up with B-Line Series B-11 thru B-72 channel. Angle clips may be used in wood joist construction when similar and equivalent to B-Line B-3060 or 3061.
14. Hangers attached to wood construction shall be attached by use of eye bolts, coach screws or lag bolts when load bearing ratings maintain a safety factor of 5.

15. All other means of support i.e., special construction, pipe stands, earthquake bracing, sway bracing, etc., shall be provided as required and in conformance with jurisdictional authority and these Contract Documents, submit all special or required support and bracing systems for review by the Architect/Engineer prior to installing any item.
16. All vertical refrigeration suction and hot gas, and all steam piping shall be provided with insulation shields and calcium silicate inserts at each support location.
17. All piping systems exposed to motorized traffic shall be fully protected by installation of concrete-filled pipe bollards. Bollards shall be cleaned and painted as directed by the Architect.

C. Acceptable Manufacturers:

1. Manufacturers acceptable to this Specification are as follows, all other manufacturers must submit for acceptance.
 - a. B-Line
 - b. Fee & Mason
 - c. Grinnell
 - d. P.H.D.
 - e. Michigan
 - f. Tolco

2.6 IDENTIFICATION MATERIALS FOR PIPING AND EQUIPMENT

A. Materials for identification shall be as follows:

1. Metal Tags: Round brass discs, minimum 1-1/2" diameter with edges ground smooth. Each tag shall be punched and provided with brass chains for installation.
2. Engraved Nameplates: Fabricate from plastic sheet stock of sufficient thickness to allow engraved lettering in contrasting color. Attach nameplates to equipment with screws.
3. Semi-rigid Plastic Identification Pipe Markers: Seton Setmark with legend, size and color coding per ANSI A13.1 Direction of flow arrows are to be included on each marker, unless otherwise specified.
 - a. Setmark Type Snap-Around markers to be used on diameters 3/4" thru 5".

- b. Setmark Type Strap-Around markers to be used on diameters 6" or larger.

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
Ductwork and Equipment	NA	2-1/2"

2.7 FREEZE PROTECTION SYSTEMS FOR PIPING AND EQUIPMENT (HEAT TRACING)

A. General:

1. Provide freeze protection for all water, sewer, sumps, tanks, pumps, etc., where piping and equipment are subject to ambient temperatures of less than 35 deg.F, and as indicated on Contract Drawings.
2. Approved Manufacturers: Raychem, Thermon.
3. Freeze protection shall consist of electrical self regulating semi-conductive "core" heat cable complete with all accessories including but not limited to an adjustable thermostat sensing the pipe or vessel contents temperature in lieu of ambient sensing, and contactors to enable power to the heat cable when temperature is below thermostat setpoint.
4. The self-regulating heater shall consist of two (2) 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed over itself without overheating, to be used directly on plastic pipe, and to be cut to length in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.

(Optional: For installation on plastic piping, the heater shall be applied using aluminum tape (AT180). To provide a good ground path where none exists and to enhance the heater's ruggedness, the heater shall have an outer braid of tinned-copper and an outer jacket of modified polyolefin (-CR).

5. In order to provide energy conservation and to prevent overheating, the heater shall have a self-regulating factor of at least 90 percent. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heater output going from 40°F pipe temperature operation to 150°F pipe temperature operation.
6. The heater shall operate on line voltages of either 120 or 208-277 volts without the use of transformers.
7. Heater shall operate from a circuit breaker for each tracing circuit.

8. The heat tracing shall maintain minimum "contents" temperature of 40 deg.F at ambient temperature of -20 deg.F when enclosed within a minimum of 1" fiberglass insulation on piping and vessels and pumps, no insulation required on sumps, etc., unless otherwise indicated.

9. Installation:

- a. Apply the heater linearly on the pipe after piping has been successfully pressure tested. Secure the heater to piping with cable ties or fiberglass tape.
- b. Apply "electric traced" signs to the outside of the thermal insulation.

10. Tests:

After installation and before and after installing the thermal insulation, subject to testing using a 2500 VDC megger. Minimum insulation resistance should be 20 to 1000 megaohms regardless of length.

B. Manufacturers:

1. Manufacturer:	Raychem	Raychem	Raychem
2. Product:	Chemelex	Chemelex	Chemelex
3. Trade Name:	XL-Trace	XL-Trace	XL-Trace
4. Pipe Size:	½"-3"	½" - 3"	4" & Larger
5. Product No.:	5XL-1	5XL-2	8XL-2-CR
6. Voltage:	120V	277V	277V
7. Max Circuit Length:	270 Ft.	470 Ft.	350 Ft.
8. Thermal Rating:	5 Watts/Ft.	5 Watts/Ft.	8 Watts/Ft.
9. Connection:	RAYCLIC-PL	RAYCLIC-PL	RAYCLIC-PL
10. Splice Kit & Tee Kit:	RAYCLIC-T	RAYCLIC-T	RAYCLIC-T
11. End Seal Kit:	RAYCLIC-S	RAYCLIC-S	RAYCLIC-S
12. Thermostat:	RAYCLIC-E	RAYCLIC-E	RAYCLIC-E
13. Glass Cloth Adhesive Tape:	GT-66	GT-66	GT-66

C. Responsibilities:

1. Heat trace including all accessories shall be furnished as part of the Work included in Division 21/22/23. Installation of cable on pipe including splices, strapping and bulb placement shall be by Division 21/22/23 Contractor.
2. Installation of power wiring including breakers and mounting thermostat enclosure shall be part of the Work included in Division 26.
3. Work under Division 21/22/23 includes coordination of material quantity and delivery, tracing installation, and insulation of piping after heat trace has been installed, inspected and tested.

2.8 DIELECTRIC PIPE FITTINGS AND ISOLATORS

A. Manufacturer: Epco Sales Inc., Victaulic.

B. Schedule: (complete unions)

Model:	FX	GX
Sizes:	½" thru 2"	2" thru 12"
Maximum Pressure:	250 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F
Epconite Gasket:	#2	#2
Ends:	FPT x Solder	FPT x Solder
Type:	Union	Flanged Union

C. Schedule: (companion flanges)

Model:	X	W	H
Sizes:	1-1/2" - 10"	1-1/2" - 12"	1-1/2" - 12"
Maximum Pressure:	175 psi	175 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F	210 deg. F
Epconite Isolators:	#2	#2	#2
End Style:	Solder (Brass)	Weld neck	Iron Pipe Thread
Type:	Companion	Companion	Companion
Face Gasket:	Same as Isolators		

D. Dielectric fittings shall conform to ASA B16.8, and shall be plated as applicable a minimum of .0005" and have no flow restriction when assembled.

2.9 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron, or ANSI/ASTM B16.3 malleable iron.
2. Joints: Screwed, or grooved mechanical couplings.

B. Copper Tubing: ASTM B88, Type M, hard drawn.

1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
2. Joints: ASTM B32, solder, Grade 95TA.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. General: Unless otherwise specifically indicated on Drawings or in Specifications, install equipment and materials in accordance with recommendations of manufacturer, including performance of tests as manufacturer recommends.
- B. Protection:
 - 1. Close ends of pipe and ductwork during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Cover floor drains and protect fixtures and equipment against damage during concrete pours and mechanical work.
- C. Quiet Operation and Vibration:
 - 1. All work shall operate in accordance with Section 230540 - Mechanical Sound and Vibration Control under all conditions of load.
 - 2. Sound or vibration conditions not in accordance with Section 230540 and considered objectionable shall be corrected in a manner approved by the Architect under the Work of Division 21/22/23.

3.2 WELDING

- A. Joints between sections of pipe, between pipe and fittings, shall be fusion welded. Use only certified welders. Strength of finished welded joints to be equal to strength of pipe. Width of finished weld to be at least 2-1/2 times the thickness of the part joined. Thickness of weld to be at least 25% greater than the thickness of pipe or fittings. Finished welded joints to present neat and workmanlike appearance.
- B. Make no direct welded connections to valves, strainers, apparatus, and related equipment. Make connections to flanged valves, and flanged equipment with welded pipe connection flanges.
- C. Radii of weld ells to be 1-1/2 times nominal diameter of fittings. Fittings used for all branch connections, whether full-size or reducing, to have interior surfaces smoothly contoured. Wall thickness of welded fittings equal to adjacent piping.

3.3 ELECTRIC WIRING

- A. Furnish equipment requiring electrical connections to operate properly and to deliver full capacity at electrical service available.
- B. All control wiring to be in accordance with manufacturer's recommendations; all wiring shall be color coded to facilitate checking.

- C. Unless otherwise indicated, all mechanical equipment motors, starters, and controls shall be furnished, set in place, and wired in accordance with the Electrical Equipment/Wiring Responsibility Matrix on the drawings. Contractor should note that the intent of this electric wiring matrix is to have the Division 21/22/23 Contractor responsible for coordinating all control wiring as outlined, whether or not specifically called for by the mechanical or electrical drawings and specifications. Mechanical Contractor shall comply with the applicable requirements of Division 26 for electrical work of this Division 21/22/23 which is not otherwise specified. No extras will be allowed for Contractor's failure to provide for these required items. The Division 21/22/23 Contractor shall also refer to the Division 26 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ELECTRICAL EQUIPMENT/WIRING RESPONSIBILITY MATRIX

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Equipment Motors	MC	MC	EC	MC
Motor Starters & Overload Heaters	MC - Except when shown in MCC	EC	EC	MC
Fused & Unfused Disconnect Switches, Thermal Overload & Heaters	EC	EC	EC	--
Manual Switches & Speed Control Switches carrying full load currents.	MC	EC	EC	EC
Control Relays & Transformers for control power	MC	MC	EC	MC
Thermostats (Line Voltage)	MC	EC	EC	EC
Temperature Control Panels	MC	MC	EC	MC
Building Fire Alarm System Fire & Smoke Detectors, including Relays in Starters for Fan Shutdown.	EC	EC	EC	EC
DDC Interface to Fire Alarm System	MC	MC	EC	MC
Electric Plumbing Fixtures, Sensor Faucets, Sensor Flush Valves, Electric Water Coolers, and required transformers.	MC	MC	EC	MC
Motor & Solenoid Valves, Damper Motors, PE & EP Switches, Control Valves, Low Voltage Thermostats.	MC	MC	MC	MC
Pushbutton stations & pilot lights (manually operated Switches not carrying load currents).	MC	MC	N/A	MC

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Pushbutton stations & pilot lights carrying full load currents.	MC	EC	EC	N/A
Exhaust fans when switched with room lights.	MC	MC	EC	EC
Boiler Controls including Gas Train	MC	MC	EC	MC
Fire sprinkler system alarms, tamper switches, flow switches and fire alarm systems tie-ins to provide a complete fire protection system.	FPC	FPC	FPC	FPC
Temporary Heating Connections	MC	MC	EC	MC
Freeze Protection Heat Cable	MC	MC	EC	MC
Variable Frequency Drives	MC	MC	EC	MC
Smoke Dampers and Detectors for activation of smoke dampers	MC	MC	EC	MC

- * MC = Mechanical Contractor under Division 21/22/23 of the work.
- * FM = Mechanical Contractor under Section 212200 - FM-200 Fire Suppression System.
- * FPC = Fire Protection Contractor.
- * EC = Electrical Contractor under Division 26 of the work.
- * MGES = Medical Gas Equipment Supplier (Section 226313).

- D. All temperature control conduit and wiring shall be furnished and installed under Section 230900. All motorized damper and motorized valve wiring shall be furnished and installed under Section 230900.

3.4 SLEEVES, PLATES AND CLOSURES

- A. Division 21/22/23 Contractor shall provide and locate pipe sleeves, and inserts required before new floors and walls are built or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed or where incorrectly located.
- B. Provide sleeves for mechanical piping passing through concrete floor slabs and through concrete, masonry, tile, and gypsum wall construction. Provide metal collars to close and protect openings.
- C. Where sleeves are placed in exterior walls below grade, pack spaces between the pipe or conduit and the sleeves with Hornflex Thiokol L-32 Sealant or Link Seal and make water-tight. Provide metal rodent collars securely fastened to structure.
- C. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe only and the insulation shall be made to butt against the construction, except for pipes requiring insulation having a vapor barrier,

in which case, the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations, make actual lengths to suit the following:

1. Terminate sleeves flush with floors, walls, partitions, and ceilings.
 2. Seal annular space around pipes watertight at floor penetrations.
 3. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor.
 4. In all areas where pipes are exposed, extend sleeves 1/4" above finished floor, except in rooms having floor drains, where sleeves shall be extended 2" above floor and in Kitchens and Mechanical Equipment Rooms, where sleeves shall be extended 4" above floor.
- D. Sleeves shall be constructed of 24 gauge galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated on the drawings. "Crete Sleeve" (plastic type) sleeves are acceptable for concrete construction as manufactured by Sperzel Division, Shamrock Industries.
- E. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is placed or when other construction is built around them.
- F. Provide tight fitting floor and ceiling plates on pipes passing thru walls, ceilings, and floors. Nickel or chrome plated in finished areas, galvanized cast iron in unfinished areas. Provide wall and ceiling flanges for ducts in finished areas.
- G. Provide all cutting, patching of holes, openings, notches. Obtain written approval for notching, boring, chipping, burning, drilling, welding to structural members in accordance with the General Conditions of the Contract and paragraph 3.7 of this Section.
- H. Where pipe sleeves penetrate fire rated walls and floors, this contractor shall use fire safing to seal openings.

3.5 FOUNDATIONS, PADS AND CURBS

- A. Provide dowels, anchor bolts, groutings, concrete foundations and pads for pumps, plumbing, heating and ventilating or air conditioning equipment in accordance with Concrete Specifications.
- B. Dimensions and exact locations for foundations and concrete curbs for mechanical equipment to be field verified and located accurately by Division 21/22/23 Contractor.

3.6 EXCAVATING AND BACKFILLING

- A. Excavate for all mechanical equipment such as fuel tanks, ductwork, sump pumps, manholes and trenches for underground pipelines to required depths. Compact bottoms of excavations. Slope to obtain required grade. Remove rocks, trash and debris before

installation of equipment and backfilling. Backfill by hand tamping earth under the haunch of the pipe to specified compaction. Backfill and compact in thin layers until top of pipe is covered. Complete backfill by methods required or directed for soil characteristics to comply with the Architectural section of these specifications.

- B. Excavations near footings shall be such that, when nearing building footings, or bearing foundation walls, the excavation bottom shall not be nearer the footing than a normal 45 degree bearing line from edge of footing bottom to bottom of excavation. When it is necessary to perpendicularly cross under a continuous foundation wall, care shall be taken to insure that crossing is clear of the structural foundation and of minimal width.
- C. Do not place backfill over pipe lines until lines are properly tested.
- D. When trenching through specially tested areas, such as paving, asphalt, etc., Contractor shall be responsible for restoring the surface to its original condition, and in a manner approved by the Architect. Repair trenches where settlement occurs, and restore the surface for the period of one year after final acceptance of the project. All cutting of paving, asphalt, etc. shall be by saw cutting.

3.7 CUTTING AND PATCHING

- A. Openings in New Construction:
 - 1. Provisions for New Openings: The Division 21/22/23 Contractor shall verify all openings required in the new construction in connection with the work under Division 21/22/23 with the Architectural and Structural Drawings and shall then meet with and verify same with the General Contractor/Construction Manager who will assign the work to the appropriate contractor to provide all openings in the new construction of the correct size and location in walls, floors or through roofs required for the installation of the mechanical work.
- B. Cutting in New Construction:
 - 1. Failure on the part of the Division 21/22/23 Contractor to make the above arrangements for required openings shall cause the cost of cutting and patching for the necessary openings for the installation of his work to be borne by him, either by being assigned to the General Contractor/Construction Manager or in the form of performing the required cutting himself. In either case, all patching shall be done by the appropriate finishing contractor as determined by the General Contractor/Construction Manager. No cutting or drilling of holes shall be done without approval of the Architect/Engineer.
- C. Patching in New Construction:
 - 1. The appropriate finishing contractor as determined by the General Contractor/Construction Manager shall patch all openings in the new structure. All openings made in fire rated walls, floors, or ceilings, shall be patched and made tight to conform to the fire rating for the enclosure. All materials used in

patching shall match the materials specified in the Architectural Specifications and all patched areas shall be restored to the specified finish surface to the satisfaction of the Architect.

2. The Division 21/22/23 Contractor shall pay the appropriate Finishing Contractor as determined by the General Contractor/Construction Manager for all patching resulting from cutting to accommodate mechanical work.

3.8 PIPE HANGERS/SUPPORTS

- A. Use inserts, anchors, expansion bolts or other approved and acceptable means of attachment to concrete construction. Set inserts in advance of concrete installation, provide required reinforcement rod for all inserts carrying loading equivalent of one 4" pipe or more. All inserts shall be flush with face of slab or wall containing insert.
- B. Provide flat square washers for rods thru metal decking with nut above washer, when acceptable and approved.
- C. Cinch hangers to carry appropriate share of loading and slope piping without sags or "pocketing" as appropriate and required.
- D. Rod offsets, or angle installation, plumber tape or wire will not be accepted. Hanger rods shall be true and plumb.
- E. Piping shall not be hung from other piping or equipment items. Provide attachments to building structure only. Use trapeze, wall brackets, knee brackets, etc., where hanger rods cannot be attached within spacing plumb to structures.
- F. Provide sway and earthquake bracing where required in accordance with Section 230548 - Mechanical Seismic Control.

3.9 INSTALLATION OF VALVES

- A. General:
 1. Provide valves as shown on Contract Documents and as required for pressure relief, balancing and/or control of flow.
 2. Provide isolation valves for maintenance and service on each piece of equipment regardless of whether or not shown on Contract Drawings.
 3. Provide isolation valves for all branch line take-offs that serve more than two items of fixtures or equipment.
 4. Provide balancing valves for each leg of domestic hot water return piping of two branches or more, all heating/cooling water returns and/or supplies to equipment as shown on Contract Documents.
 5. Provide access means for each valve or group of valves either by access panels or utilization of inherent access provided by building methods i.e., lift out ceiling construction or exposed valve installations in non critical areas such as janitors closets, storage rooms, etc.

6. Install all valves with valve bonnets or operating stems in vertical (upright) position when possible, valves may be installed with bonnets or stems not less than 35 degrees downward from vertical plane except valves on vertical piping may be 90 degrees from vertical plane. Swing type check valves shall be installed on horizontal piping no more than 45 degrees upward slope from horizontal plane, using lift checks on vertical piping. Lift check valves shall not be used on sewage or sump pump discharge piping.
7. Inspect and tighten all bonnet nuts, bolts, packing glands, lubricate all valves requiring lubrication, secure all hand wheels and identification plates, be responsible for all valves having manufacturers name, trade name, working pressure and size stamped or cast into the body of the valve. Perform all maintenance, repacking and inspection prior to installation of valve.

B. Proper Installation of Valves:

1. Provide valves in accordance with the following schedule unless specified otherwise in Contract Documents.
 - a. Dead-end shut off: Gate, ball, butterfly, plug, stop and drain.
 - b. Throttling: Ball, plug, globe, diaphragm, needle, butterfly (when using butterfly valves for throttling, additional valves must be provided for service shutoff.)
 - c. Backflow prevention: Check.
 - d. Water hammer prevention: Silent or pilot operated non slam check.
 - e. Gas piping: Lubricated plug (or ground joint cock up to 1" only), or UL-Listed ball valve.

C. Removal and Repair Provisions:

1. Provide all valves which are not accessible for repair without removal from piping with union connection immediately adjacent to valve outlet.

3.10 PAINTING

- A. Surfaces of exposed equipment and materials to be thoroughly cleaned and left ready for painting in accordance with Architectural Painting Specifications.
- B. Duct interiors visible through registers, grilles and diffusers shall be painted flat black.
- C. All other painting of mechanical equipment and piping, unless otherwise noted, shall be performed under other divisions of the work with the exception of identification of piping and equipment which will be the responsibility of the Division 21/22/23 Contractor.

3.11 IDENTIFICATION OF PIPING AND EQUIPMENT

- A. General: Provide pipe identification, valve tags, stencils, or engraved nameplates to clearly identify the mechanical equipment, piping and controls of the various mechanical systems and direction of flow in piping.
- B. Methods for identification shall be as follows:
 - 1. Metal Tags: Stamp tags with letter prefixes to indicate service, followed by a number for location in system.
 - 2. Engraved Nameplates: Attach nameplates with brass screws. Pressure-sensitive embossed labels are not acceptable. Nameplates shall bear the same identifying legend used on the Contract Documents.
 - 3. Pressure Sensitive Markers: Apply pressure sensitive markers in accordance with manufacturer's recommendations with complete wrap around may be used at Contractor's option. Marker adhesion will be tested for permanence. Any markers showing dog ears, bubbles, or other failings shall be replaced.
 - 4. Semi-Rigid Plastic Identification Markers: Seton Setmark premolded (not pressure sensitive) identification markers may be used at Contractor's option on service piping which is accessible for maintenance operations (but not on piping in finished spaces). This type marker shall not be installed on bare pipe when surface temperature exceeds 180 deg.F unless a 1" thick insulation band is first provided under marker for protection from the hot pipe.
- C. Identification of Piping: Identify all piping accessible for maintenance, as well as exposed to view utilizing semi-rigid plastic markers, according to the following procedures:
 - 1. Use an arrow marker for each pipe-content legend. The arrow shall always point away from the pipe legend and in the direction of flow: color and height of arrow to be same as content legend lettering.
 - 2. If flow can be in both directions, use a double-headed arrow indication.
 - 3. Apply pipe legend and arrow indication at every point of pipe entry or exit where line goes thru wall or ceiling cut.
 - 4. Apply pipe legend and arrow indication within 3" of each valve to show proper identification of pipe contents and direction of flow.
 - 5. The legend shall be applied to the pipe so that lettering is in the most legible position. For overhead piping, apply legend on the lower half of the pipe where view is unobstructed, so that legend can be read at a glance from floor level.
 - 6. For pipes under 3/4" O.D., fasten brass tags securely at specified legend locations.
 - 7. Insulated piping equipped with electric heat trace shall additionally be labeled "Electric Traced" with label of same size and color as the pipe legend.
- D. Valves: All valves, including but not limited to domestic hot and cold water, hot water recirculation, heating water, chilled water, condenser water, steam, steam condensate return, fire protection, gas, medical gas, vacuum and special service valves located inside the building, shall be tagged and identified as to type of service, location number, and normal valve position (normally open or normally closed).

- E. Controls: All magnetic starters and relays, shall have nameplates or be stenciled to identify connecting or controlled equipment. All manual operating switches, fused disconnect switches and thermal over-load switches which have not been specified as furnished with indexed faceplates shall also have nameplates or be stenciled as to "connected" or "controlled" equipment. All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays, and starters shall be clearly identified.
- F. Pumps: All pumps shall be identified as to service and zones served. Base mounted pumps shall be stenciled or have system served nameplates. Brass tags secured by brass chains may be used on small in-line pumps.
- G. Storage Tanks, Water Treatment Equipment and Heaters: All tanks and heaters shall be stenciled as to service. The connecting pipes to each shall be identified and the service temperature entering and leaving the tank or heater shall be indicated.
- H. Fans: All supply and exhaust fans and air handling units and connecting ductwork supplying one or more areas from an equipment room or isolated crawl or furred space shall have nameplate or be stenciled as to plan code number, service and areas of zones served.
- I. Air Conditioning Equipment: Air conditioning equipment shall be identified by system nameplates.
- J. Access Doors: Provide engraved nameplates or painted stencils to identify concealed valves, controls, dampers or other similar concealed mechanical equipment. Obtain Architect approval before installation on all access doors in finished areas.
- K. Lift Out Ceilings: Provide engraved nameplates on ceiling tee stem to identify concealed valves, controls dampers or similar concealed mechanical equipment which is directly above nameplate in ceiling space. Obtain Architect approval before installation.
- L. Expansion tanks shall be labeled to indicate system served and precharge pressure.
- M. Access Flooring: Provide thin engraved nameplate on access panel to indicate location of underfloor fan coils and smoke/fire dampers.

3.12 DRIP PANS

- A. Provide drip pans under all fluid conducting piping which runs over electric switchgear, busway, or electric motor starters, and under all point-of-use water heaters.
- B. Pans: 18 gauge galvanized iron. Pans shall be two inch deep, with rolled top edges, and shall extend six inches each side of the pipe or group of pipes and six inches beyond the equipment below. Keep pans as close to the underside of the pipes as practicable. All seams shall be soldered, and pans shall be crossbraced as required to prevent sagging and warping.

- C. Pitch each pan to a drain connection, and pipe a 1-1/2 inch or larger copper tube drain to discharge over nearest available open drain.

3.13 FIRE SAFING

- A. Mechanical Contractor shall provide fire safing for his work as follows: Where fire rated separations are penetrated by pipes, conduit or ductwork, the annular space around the pipe, conduit or ductwork shall be filled with a U.L. Rated fire safing material. Refer to Division 7 for materials and application specifications.

3.14 HEAT MAINTENANCE CABLE AND FREEZE PROTECTION CABLE

- A. Comply with National Electric Code Section 427 for installation.
- B. Protect heater strips from damage before, during and after installation.
- C. Provide waterproof insulation for all heat traced and heat maintained piping one inch thick minimum in accordance with Section 230700.
- D. When installing do not twist buss wires together.
- E. Test each circuit prior to and immediately after installation of thermal insulation using a megger under 500 volts D.C. Minimum insulation resistance reading shall be ten (10) megohms regardless of length, if less than ten (10) megohms investigate cause and replace damaged sections - do not repair!
- F. Install heat cable on lower quadrant of pipe 45 degrees up from vertical, provide ties or fiberglass tape 12" on center max.
- G. Install all accessories and kits per manufacturers' recommendations and standards. Careful attention to manufacturers' installation instructions as pertains to valves and equipment will be strictly adhered to and enforced.

3.15 DIELECTRIC PIPE FITTINGS AND ISOLATORS

- A. Provide dielectric pipe fittings and isolators at all connections between dissimilar metals in the domestic water, heating water and fire protection systems to control corrosion potential caused by galvanic or electrolytic action.
- B. Typical locations for dielectric isolation are; water heaters, storage and pressure tanks, water conditioning equipment, pumps, changes in service piping materials, make-up connections to boilers and chilled water systems, valves, deaerators, flexible connectors and the like where materials of different electrode potential are joined.

- C. Hangers for piping shall be isolated per Section 230529 when hanger and piping materials are dissimilar and subject to production of electrolysis or galvanic action.
- D. Storage tanks shall be isolated from piping and tank stands by use of anti-electrolytic and galvanic isolators.

3.16 DRAIN LINES

- A. Provide condensate drain lines from each cooling coil drain pan to drain or to termination indicated. Drain lines to be galvanized pipe or Type M hard copper.

3.17 HEATING SYSTEM USED FOR TEMPORARY HEAT DURING CONSTRUCTION

- A. Permanent heating system shall not be used until building is totally and permanently enclosed (no temporary barriers for weather protection), and source of heat supply is permanently installed.
- B. Once the heating system has been placed into operation, it shall not be shut down except for moderate weather, and all heated areas shall be maintained at a minimum temperature of 50 deg. F 24 hours a day.
- C. When any air-handling equipment is used for temporary heat, the filters shall be installed and maintained. Before building acceptance by Owner, these units shall be thoroughly cleaned and new filters shall be installed. This is over and above the extra set of filters to be provided the Owner as called for in the specifications. Coils shall be cleaned if necessary, as determined by the Engineer.
- D. Any and all systems being used for temporary heat shall become the Contractor's responsibility to maintain, and be put into first class working order before acceptance by the Owner.
- E. Any manufacturer's guarantees that start with the use of equipment for temporary heat shall be extended by the contracting firm holding the prime contract for construction, so that the Owner will have his one-year guarantee from date of acceptance.

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END OF SECTION 230529

SECTION 230900 – ELECTRONIC CONTROLS

PART 1 - GENERAL

1.1 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

- B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230700 - Mechanical Insulation
Section 232113 - HVAC Piping & Specialties
Section 232123 - HVAC Pumps
Section 235200 - Boilers
Section 233400 - Air Handling Fans
Section 237400 - Air Handling Systems on Roof
Section 233300 - Ductwork and Accessories
Section 230593 - Testing, Adjusting and Balancing
Section 230800 - Commissioning of HVAC

1.2 SYSTEM DESCRIPTION

- A. The work includes but is not limited to the following:
1. The automatic control system shall be direct digital controls (DDC). PID (Proportional Integral, Derivative) control algorithms shall be applied on all temperature, indoor air quality, and pressure applications as called for hereinafter in the control sequences.
 2. Central building automation system with web-based stand-alone master controller, unit controllers for all controlled devices to communicate with master controller. The master controller shall be capable of trend logging all indoor air quality sensors on an hourly basis for a period of one year, and any other measured variables for a period of at least 3 months. Central BAS system shall be compatible with the existing Utah National Guard remote access systems by CSI Controls and shall be provided with a router for connection to the Utah National Guard DDC network located in Draper, Utah.
 3. All control devices, valves and automatic dampers, wire, conduit, etc., as specified and required and connected so as to perform all functions and operate according to the specified sequences.
 4. Provide classroom training of at least 8 hours to familiarize Owner personnel with the system after system acceptance by the commissioning agent.

5. Provide 16 hours of additional training for Owner personnel after classroom instruction during the warranty period, at Owner's request.

1.3 QUALITY ASSURANCE

- A. Manufacturing and Installation Qualifications:
 1. The Controls Subcontractor firm executing the work of this section shall have 10 years experience in work of similar scope and nature to that specified.
- B. This work includes all material, equipment and appurtenant accessories necessary for or incidental to the installation of a complete DDC system of Automatic Temperature Controls.
- C. All device controllers shall be application specific controllers (ASC) by the same manufacturer and shall be compatible with the existing Utah National Guard systems by CSI Controls.

1.4 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings and manufacturer's data for the following items in accordance with the General Conditions of the Contract:
 1. Sensors.
 2. PI & PID Controllers
 3. Automatic control valves, schedule and wiring.
 4. Thermostats.
 5. Thermometers.
 6. Gauges.
 7. Control diagrams
 8. Wiring diagrams
 9. Control panels.
- B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.
 1. Controls and instrumentation.
- C. Certificate: ATC Contractor shall submit a letter certifying completion of the control system in accordance with the Contract Documents.
- D. Commissioning: Submit completed Commissioning Checklist FC-7, Controls.

PART 2 - PRODUCTS

2.1 SENSORS

- A. Temperature sensors shall be of the thermistor (NTC) type with a high resistance change versus temperature change to insure good resolution and accuracy. Sensors shall be available for room, duct or well mounting. Sensors shall connect to remote controller by means of a two-wire unshielded cable. Room type sensors shall be available with built-in setpoint potentiometer. Sensors shall be available in various ranges to properly suit the application.
- B. Carbon Dioxide Sensor and Transmitter: Carbon Dioxide (CO₂) sensors shall be Vaisala Model GM, or approved equal. Wall-mounted sensors shall be Model GMW21. Duct-mounted sensors shall be Model GMD20. Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output, for wall mounting.
- C. Zone dampening sensor element shall be suitable for duct mounting and capable of dampening an individual zone sensor by electronically paralleling the zone sensor's signal. Sensor shall connect to controller by means of a two-wire unshielded cable. Sensor shall be of the thermistor (NTC) type.
- D. Strap-on type sensor shall vary its resistance over its entire range of sensed water temperature from 50°F to 230°F in a pipe 3/4" to 2-1/2" in diameter without requiring immersion or well mounting. Sensor shall connect to controller by means of a two-wire unshielded cable. Sensor shall be of the thermistor (NTC) type.
- E. Duct-mounted averaging type temperature sensor shall utilize a nickel resistance sensing element incorporated in a copper capillary of 27 feet. The sensor shall vary the output voltage with a change in temperature. Sensor shall connect to the remote controller by means of a three-wire unshielded cable. Temperature sensors utilized for freezestat purposes shall be mounted within 6" of bottom of an air handler floor.
- F. Differential pressure sensor shall vary the output voltage with a change in differential pressure. The sensor shall connect to the remote controller by means of a three-wire unshielded cable.
- G. Air velocity sensor shall be capable of linear indication of the velocity of air in a duct from 0 to 3000 FPM, and shall vary its output voltage with a change in air velocity. The sensor shall connect to the controller by means of a four-wire unshielded cable.
- H. Outdoor air sensor shall be of the thermistor (NTC) type with a high resistance change versus temperature change. Sensor shall be available for outdoor or duct mounting. Sensor shall connect to remote controller by means of a two-wire unshielded cable. Outdoor type sensor shall be available with integral wind sensor which changes its output voltage with a change in wind velocity. Combination sensor shall connect to controller by means of five-wire unshielded cable.

- I. Duct sensor/adaptor shall be of the thermistor (NTC) type and suitable for mounting directly to the back of the integral sensor/controller making it capable of duct temperature sensing as a single unit.

2.2 PRIMARY HVAC CONTROLLERS

- A. Temperature/humidity/pressure controllers shall be plug-in proportional type with integrated circuits. Controllers shall be capable of having up to three separate outputs. Each output shall have separate zero and proportional band adjustments such that a single controller may operate heating and cooling with an adjustable dead band to meet D.O.E. requirements. Indicating lamps shall be provided for each output which will vary in intensity to indicate amount of output. Controller shall be available with either 0 - 20 VDC proportional output, two position, or any combination. Controller shall have internal switches for each output to change the output signal to either direct or reverse. Controller shall be available with integral electronic circuit for absolute high or low limit control.
- B. Three-in-one controllers shall be a single unit capable of producing a discreet 0-20 VDC proportional output, one for each of three separate sensors. The three outputs shall have individual setpoint, zero adjustment and proportional band. Each output shall be provided with output lamps that vary in intensity to indicate the amount of output.
- C. Three mode rate reset controller shall be of the proportional/ on-off type with adjustable integral and derivative actions. The controller shall be available with one or two outputs. Each output shall have individual zero adjust and output lamps which varies in intensity as the output varies. Each output shall be field selectable for direct or reverse action, and 0-20 VDC proportional or 0/20 VDC binary output. The controller shall be supplied with a switch to eliminate the integral and derivative functions for calibration purposes.
- D. The sequencing controller shall be capable of receiving a proportional signal from a controller and outputting two discreet sequenced signals with individual zero and steepness adjust for each. Controller shall be supplied with a switch to select a direct or reverse-acting output. Each output shall have individual indicating lamps which vary in intensity at output varies.
- E. Averaging controller shall be capable of receiving up to ten (10) 0-20 VDC signals from controllers and outputting two separate control signals, one the average of the cooling demands and the other the average of the heating demands. Each shall have individual steepness adjust and individual indicating lamps which vary in intensity as output varies. Controller shall be supplied with switches to select direct or reverse-acting output signals.

2.3 TERMINAL UNIT CONTROLS (VAV)

- A. Each smart variable air volume controller shall be based on a minimum 8 bit microprocessor with control algorithms and default set points embedded in non-volatile memory and shall regulate zone temperature by regulating the volume of air supplied to

the zone. This is accomplished by controlling zone air velocity at an appropriate setpoint which is reset by the space temperature. A PID type control algorithm shall reduce offset and overshoot. Proportional control shall not be acceptable. Each controller shall be stand-alone and have the following independently adjustable setpoints:

3. Heating Temperature
 4. Cooling Temperature
 5. Maximum Cooling Velocity
 6. Minimum Velocity
 7. Maximum Heating Velocity
 8. Space CO2 / Outside air differential
- B. Each controller shall be remotely addressable over a twisted/shielded multidrop pair of wires by a higher level computing device. Remote communications shall enable the following capabilities:
3. Reset all Setpoints
 4. Read all Setpoints
 5. Read Zone Temperatures
 6. Read Duct Velocity
 7. Initiate Zone Morning Warmup Mode
 8. Initiate Zone Night Setback
- C. Control, communication, and power circuits for each controller shall be electrically isolated to protect against transients and steady state pick-up.
- D. Controller setup shall be simplified by function switches on the controller which command damper open or closed, go to minimum or maximum velocity, and exercise heat assist outputs. Under normal operation, these function switches shall be used to create an address, unique to each individual controller. Any address between 01 and 31 shall be possible.
- E. All controllers shall be suitable for indefinite operation with or without communication to a higher level computer system.
1. Transmission rate: 19200 baud
 2. Word Length: 32 bits
 3. Operation: Asynchronous Half-Duplex Two Wire
 4. Format: Binary

2.4 INTEGRAL SENSOR/CONTROLLER

- A. Controllers shall be available with one or two outputs of either the two position or 0-20 VDC proportional type. Each output shall have individual dead band and proportional band adjustments. Time proportioned three point floating type output controller shall have single output with PID characteristics such that sustained system offset is eliminated, and shall have time adjustment to coordinate damper stroke time with controller output, controllers shall have lamps to appropriately indicate controller output.

Outputs shall be individually field adjustable for direct or reverse action. Controller shall be supplied with equipment necessary to effect adjustable night setback from a contact closure or adjustable low limit control from a sensor signal. Control shall be available as integral duct sensor/controller, or shall be capable of remote sensor and/or setpoint mounting. Two output controllers shall have adjustable dead band capable of meeting D.O.E. requirements.

2.5 HOT WATER CONTROLLERS

- A. Weather dependent changeover controller shall be capable of binary switching based on outdoor temperature, and shall be available with one or two independent switches with individual setpoint differential, and switch for reverse or direct action switching. Controller shall be capable of receiving a varying electronic signal from a solar sensor for automatic reset of control point due to solar load. Output lamps shall be provided to indicate individual contact status. Controller shall be capable of fully adjustable night set-back or setup.
- B. Constant temperature controller shall be of the proportional type with integral reset action to eliminate sustained system offset. The controller shall have a switch for selecting long or short integral reset times. Controller shall have an indicating lamp that will vary in intensity with controller output.
- C. Hot water reset temperature controller with limits shall be of the time proportioned 3 point floating type with PDPT characteristics, or the 0-20 VCD proportional type with PI characteristics, such that the reset function eliminates sustained system offset. Controller shall be capable of resetting its control point automatically due to outdoor air temperature, and wind and/or solar loss/gain information transmitted from appropriate sensors. Controller shall be capable of adjustable night setback from contact closure. Reset schedule shall be fully adjustable with regards to outdoor air temperature, and solar and/or wind loss/gain influence. Output lamps shall be provided to indicated controller output status, on-off or varying as appropriate. Switch shall be provided on proportional controller to eliminate reset functions for calibration purposes. Limit adjustments shall be provided for maximum and minimum allowable hot water temperatures.
- D. Hot water reset temperature controller shall be of the time proportioned 3 point floating type with PDPI characteristics, or the 0-20 VDC proportional type with PI characteristics, such that the reset function eliminates sustained system offset. Controller shall be capable of resetting its control point automatically due to outdoor air temperature and wind and/or solar loss/gain information transmitted from appropriate sensors. Controller shall be capable of adjustable night setback from contact closure. Reset schedule shall be fully adjustable with regards to outdoor air temperature, and solar and/or wind loss/gain influence. Output lamps shall be provided to indicate controller output status, on-off or varying as appropriate. Switch shall be provided on proportional controller to eliminate reset functions for calibration purposes. Lamps shall be provided to indicate an adjustable below/above freezing change-over temperature. Controller shall be capable of receiving a signal from a room compensation sensor and adjusting its control point to coincide accordingly.

- E. Return water boiler controller with low limit shall be available with on 0-20 VDC proportional output and either one or two on-off outputs. It shall be capable of controlling up to three boilers based on return water temperature. Each cut-in point shall be individually adjustable. The controller shall have a 200 second switch-on time delay and shall be compatible with a return water low limit sensor to close the mixing valve if the water temperature decreases to the extent that boiler shock would result. Output lamps shall indicate controller output status, on-off or modulating as appropriate.
- F. Return water sensor/controller shall be compatible with the boiler controller to throttle closed the secondary system mixing valve should the primary return water temperature drop below its adjustable setpoint.

2.6 CONTROL VALVES

- A. Drive and valve for low volume heating water shall be for the modulating magnetic type with two-way screwed fittings. Valve shall spring return to its normal position in the absence of control power. Valve body shall be nickel plated brass, seat shall be brass, and inner valve material shall be ethylenepropylene rubber.
- B. Valves for control of refrigerants shall be of the two-way or three-way modulating magnetic type. Valve body shall be of high pressure brass with solder connections and have a seat and inner valve of chrome nickel steel. The valve shall spring return to its normal position in the absence of control power.
- C. Valves used for control of hot water shall be of the modulating magnetic type with a rangeability of at least 500 to 1. Valve body shall be cast iron, seat and inner valve material shall be chrome nickel steel. Valve sizes 2" and smaller shall be screwed and supplied with union fittings. Valve 2-1/2" and larger shall be flanged. Valves shall be of the three-way or straight-thru type as required by the sequence or shown on the mechanical drawings. Valve shall be equipped with hand wheel to allow manual position of valve in the absence of control power. Valves shall be of the spring return type that will return to their normal position in the absence of control power.
- D. Valves used for fan coil or terminal reheat shall be of the modulating magnetic type with a rangeability of at least 100 to 1. Valve body and seat material shall be bronze. The inner valve and stem material shall be stainless steel. The valve shall be of the three-way type with 4 connections and an integral bypass. Valves shall be of the spring return type that will return to their normal position in the absence of control power.

2.7 DAMPER ACTUATORS

- A. Actuators shall be of the push-pull type for either modulating or two-positioning control. Actuators shall stroke by a rotating motion of an overload-proof synchronous motor. Control voltage shall be either 24 VAC or 0-20 VDC as required by the application. Actuators shall be available with spring return to the fully extended position upon power failure. Three (3) point floating actuator shall be available with adjustable end switches. Minimum/maximum manual positioners shall be available for proportional motors.

- B. Mixing box actuators shall be of the rotary or linear drive type as required, capable of permanent stall operation without damage. Rotary drive actuators shall have adjustable stop pins for stroke limit and shall fit directly over the damper shaft. Gears shall be nickel steel. Gears and bearings shall be oil impregnated for lifetime lubrication.

2.8 RESET TRANSMITTERS

- A. The reset transmitter shall be used for both summer and winter compensation in conjunction with controllers for the gradual increase in temperature as a function of outdoor air temperature. The transmitter shall be suitable for connection to up to 100 controllers while using only one outside air sensor. Transmitter shall have the capability to interface with a solar sensor for adjustable solar compensation.
- B. The reset transmitter shall be used for both summer and winter compensation in conjunction with controllers for the gradual increase in temperature as a function of outdoor air temperature. The transmitter shall be suitable for connection to up to 100 controllers while using only one sensor. The transmitter shall have cut-in point and summer and winter reset slope adjustments.
- C. The universal reset transmitter shall be capable of receiving a signal from any one of a number of different sensors (temperature, pressure, humidity, etc.) and resetting the setpoint of up to five controllers based on a field adjustable reset schedule. The reset schedule may be either direct or reverse with high and low reset limits.

2.9 INDICATORS

- A. Remote indicator shall interface with sensor/controller to indicate measured value at the sensors. Indicator shall be capable of indicating temperature, pressure or humidity.
- B. Multiple indicator shall interface with up to six sensor/controllers to indicate measured value at the sensors. A selector switch on the face of the indicator shall determine which variable is being measured. Indicator shall be capable of indicating temperature and humidity.
- C. Industrial digital indicator shall be of the precision electronics and component type accurate to $\pm .05\%$ of measured variable indicator shall be adjustable for indicating various ranges of temperature, humidity and pressure from different voltage, current, or resistance inputs.
- D. Industrial analog indicator shall be high precision electronics and component type accurate to $\pm 1\%$ of scale range, indicator shall be suitable for indicating various ranges and shall be available as a one or two unit indicator.

2.10 ALARM UNITS

- A. The alarm indicator shall be capable of indicating a minimum of six alarms per module. When an alarm condition exists the appropriate lamp shall flash. The lamp shall continue to flash until the alarm unit has been reset regardless of whether the alarm condition has returned to normal. When the reset button is pushed and the alarm conditions still exist, the lamp shall go to a steady lit condition until the alarm has cleared. The unit shall be equipped with a lamp test button.
- B. The status indicator shall be capable of indicating a minimum of six statuses per module. The unit shall be equipped with a lamp test button.
- C. Floating alarm unit shall interface with a controller to sense setpoint and measured value. The upper and lower alarm limits shall be adjustable on the face of the alarm unit and defined as an offset from the controller setpoint. The unit shall have indicating lamps to indicate which limit has been exceeded and "dry" SPDT contacts for remote alarm. Unit shall be available as single or dual alarm unit.
- D. Stand alone alarm unit shall connect to remote temperature and/or humidity sensor and alarm when the upper or lower limits set on the face of the unit are exceeded. The unit shall have indicating lamps to indicate which limit has been exceeded and "dry" SPDT contacts for remote alarm. Unit shall be available as single or dual alarm unit.

2.11 TRANSDUCER AND INTERFACES

- A. The electronic transducer shall be of the one or two input/output type suitable for interfacing a sensor and a recorder. Start point and steepness shall be fully adjustable for various ranges. Accuracy shall be $\pm 1\%$ of final value.

2.12 TIME CLOCKS AND OPTIMIZER

- A. Time clock shall have separate 7-day and 24-hour dials, skip-a-day feature, and 12-hour spring reserve. Clock shall have selection switch for manual day, manual night and automatic operation. Clock shall be available with adjustable morning boost and shall have manual time correction adjustment.
- B. Time clock for optimizer shall have a separate 7-day and 24-hour dials, skip-a-day feature, quartz movement with interconnecting outputs, and 72-hour spring reserve. Clock shall have selection switch for manual day, manual night and automatic operation.
- C. Start time optimizer shall initiate optimum start time computations 9 hours before programmed occupancy and determined latest possible start time to need desired system conditions based on indoor and outdoor air temperature. Clock shall have morning boost capability and be compatible with quartz movement optimizer time clock.

2.13 MISCELLANEOUS

- A. High temperature cut-outs (HTCO) shall be designed to be mounted in the return air or exhaust duct system and wired to shutdown fans when air temperature rises above its setpoint. HTCO shall be of the manual reset type and supplied for all fans over 2000 CFM.
- B. Smoke detector shall be of the dual chamber ionization type to sense the particles of combustion. Smoke detectors shall be provided for all heating and cooling fans over 200 CFM and wired to shut down the fan on an alarm condition.
- C. Low limit thermostats shall be line voltage type and used to detect low temperature conditions in an air stream which could cause freeze-up conditions in water coils. Controller shall be of the liquid-filled type responsive only to the lowest temperature sensed along any one foot length of its 20 foot measuring element. Controller shall be adjustable and of the manual reset type.
- D. Flow switches shall be of the paddle type equipped with SPDT contacts to establish proof of flow. Flow switches shall be of the vapor-proof type similar to McDonnell Miller FS8-V.
- E. Line voltage to 24 VAC transformer shall be supplied as required to provide adequate control voltage to control system.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation of the automatic control system shall be made and supervised by mechanics who are full time employees of the Controls Subcontractor.
- B. All installation work shall be scheduled and coordinated with other trades to expedite job progress.
- C. The installation shall match erection of slabs and walls such that no damage, cutting or patching will be required.
- D. All work shall be installed in accordance with current control industry practices.
- E. Only top quality workmanship will be permitted.
- F. Any work not properly executed shall be removed and replaced without extra expense to the Owner.

3.2 SENSORS AND GUARDS

- A. Temperature controls trades shall verify all wall mounted sensor locations with the General Contractor in order to avoid interference with wall mounted furnishings.
 - 1. Where interferences require moving the sensor more than two feet, consult with the Engineer for new location.
- B. Calibrate each carbon dioxide sensor for site elevation (4500 ft) prior to placing into service.

3.3 FREEZE PROTECTION THERMOSTATS

- A. Provide freeze stat on the discharge of each unit to stop the fan and close the outside damper upon sensing any one foot section below 40°F.

3.4 ELECTRIC WIRING

- A. All control and interlock wiring shall be as specified in "Electric Wiring" paragraph in Section 230529 - Basic Mechanical Materials and Methods. Provide diagrams and coordinate all work with the Division 26 contractor as required.
- B. The ATC Contractor shall furnish and install all required wiring for the following subsystems:
 - 1. Water Treatment System
- C. The ATC Contractor shall furnish all necessary equipment and wiring to integrate the following:
 - 1. Boiler
 - 2. Generator
 - 3. Lighting

3.5 SERVICE AND WARRANTY

- A. The control system herein specified shall be free from defects and workmanship and material under normal use and service. After completion of the installation the controls contractor shall regulate and adjust all thermostats, control valves, damper motors and other equipment provided under this contract. If within twelve (12) months from the date of completion any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired free of charge in accordance with "Warranties" paragraph in Section 230500.

- B. The controls contractor shall after completion, provide any service incidental to the proper performance of the control system under guarantees outlined in Division 1 for the period of one year.
- C. When all devices are installed, a fully qualified technician shall set, adjust and calibrate all components.
 - 1. A letter certifying completion of the system shall be forwarded to the Engineer's office, prior to acceptance of project by Owner.

3.6 INSTRUCTION AND ADJUSTMENT

- A. On completion of the job the controls contractor shall have completely adjusted the entire control system. He shall arrange to instruct the Owner's representative on operation of the control system and supply him with three (3) copies of the control operating and instruction manuals. He shall obtain from the owner's representative a signed receipt that he has received the instruction manuals and complete instructions on the operation of the system.
- B. Record Drawing: At completion of the job the controls contractor shall furnish two (2) copies of corrected wiring diagrams, one enclosed in laminated plastic and mounted on wall of the main mechanical room or as directed.
- C. Contractor Adjustments: At the completion of the job the controls contractor must submit to the Architect a letter stating that he has made final calibrations and adjustments to the system and that the owner's operating personnel have been instructed in its use.

3.7 SEQUENCE OF OPERATION

- A. Electrical Power metering:
 - 1. Provide up to 8 DDC monitoring points for electrical power current transformers, as directed by the Owner.
- B. Rooftop Air Handling Unit RTU-1 and 2:
 - 1. Occupied/unoccupied modes of this air handler shall be determined by a four-channel load programmer and override timer located on the Automatic Temperature Control (ATC) panel.
 - 2. Occupied Mode:
 - a. When the air handler is indexed to the occupied mode, the outside and exhaust dampers shall remain closed until the return air temperature comes up to 68 degrees (adjustable). When the return air rises above 68 degrees, the outside air dampers shall open to a minimum position adjustable at the ATC panel.

- b. A discharge three-mode controller with proportional, integral and derivative action shall select the zone calling for thermostat cooling and reset the discharge air temperature from 65 to 53 degrees with adjustable limits. This controller shall sequence the return plenum unit heater, outside air dampers, 2 stages of compressor operation, and modulate the hermetic hot gas valve provided by this contractor to satisfy the reset schedule.
 - c. A differential controller sensing the outside and the return air temperatures, shall return the outside air dampers to minimum position when the outside air temperature is within 2 degrees of the return temperature. The mechanical cooling shall be locked out below 55 degrees OSA (adjustable).
 - d. Minimum outside air shall be set at 2700 CFM minimum (adjustable).
- 3. Unoccupied Mode:
 - a. The air handler shall be off, the outside air dampers shall be closed, and the cooling locked out. On a fall in space temperature below 60 degrees as sensed by zone temperature controllers, the air handler shall start to satisfy the space heating demand.
- 4. Zone Control:
 - a. All zones. A panel-mounted master/submaster controller with separate heating/cooling setpoints sensing the space temperature and zone discharge temperature with remote transmitters shall modulate hot water valve to satisfy the space heating setpoint. The cooling output of the controllers shall reset the main supply fan discharge air temperature.
- 5. Supply Fan Speed Control:
 - a. Supply fan VFD shall modulate to maintain a pressure differential between the space and discharge ductwork sufficient to operate all VAV boxes with at least one box in the full open position at any time.
- 6. Power Exhaust Fan Speed Control:
 - a. Power exhaust fan VFD shall modulate to maintain a pressure differential between the lobby and outside air.
- 7. Safeties:
 - a. Shut down all fans under smoke detector or freezestat alarm.
- 8. Interlocks:
 - a. All exhaust fans shall be interlocked to run when the supply fan AHU-1 or 2 unit is in operating, economizer mode, and to de-energize with AHU-1 or 2 shut down.

C. Rooftop Air Handling Unit RTU-3, 4 and 5:

1. Occupied/unoccupied modes of this air handler shall be determined by a four-channel load programmer and override timer located on the Automatic Temperature Control (ATC) panel.
2. Occupied Mode:
 - a. When the air handler is indexed to the occupied mode, and the outside air temperature is less than 60°F, then open return damper, close outside air damper, start fan and modulate heating water valve to maintain space temperature setpoint
 - b. Modulate return and outside air dampers to maintain space CO₂ at 530 ppm greater than outside CO₂ level
 - c. When the air handler is indexed to the occupied mode and the outside air temperature is between 60°F and 80°F, open the outside air damper, close the return damper, start the fan, and keep heating water valve closed.
 - d. When the air handler is indexed to the occupied mode and the outside air temperature is greater than 80°F, then open outside air damper, close return damper, close heating water valve, start fan, close drain valve, close flush valve, open fill valve and start circ pump. Continue to operate in this mode until 30 minutes before the end of the occupied cycle
 - At 30 minutes before end of occupied cycle, or when space temperature has stayed 4°F below Setpoint for 15 minutes, stop circ pump, open drain valve, open flush valve, close fill valve, and operate for 15 minutes
 - After 15 minutes, close flush valve, close drain valve, open fill valve, leave circ pump off, and operate fan for 15 minutes.
3. Unoccupied Mode:
 - a. The air handler shall be off, the outside air dampers shall be closed, and the cooling locked out. On a fall in space temperature below 60 degrees as sensed by zone temperature controllers, the air handler shall start to satisfy the space heating demand.
4. Relief Vent Control:
 - a. Relief vent damper shall modulate to maintain a pressure differential between the space and outside air.
5. Safeties:
 - a. Shut down all fans under smoke detector or freezestat alarm.
6. Interlocks:
 - a. AHU-5 shall index to minimum outside air when VEF-1 is on, regardless of space CO₂ level.

D. Heating Water System:

1. Upon a call for zone heating or air handler preheat, both boilers shall be enabled and the boiler primary pumps shall be enabled. The burner controls shall be monitored by the central control system. Operating status of each pump shall be monitored by adjustable setpoint motor current sensors. Upon pump or motor failure, a failure alarm shall be indicated. Pump failure alarm shall generate an automatic pager or e-mail notification as directed by Owner. The heating water temperature shall be reset from 140°F to 100°F over the range of outdoor temperature from 6°F to 60°F.
2. Upon a call for heating water from within the secondary zone, the lead secondary heating water pump speed shall modulate to maintain the differential pressure sensor setpoint. Secondary pump speed shall be controlled directly through the VFD integral PID controller. Status of all pumps shall be monitored by adjustable setpoint motor current sensors, upon loss of flow an alarm shall be indicated and the lag or backup pump shall be enabled automatically. Pump failure alarm shall generate an automatic pager or e-mail notification as directed by Owner.

E. VAV Boxes:

1. Occupied Mode:
 - a. When the space temperature is equal to or greater than the cooling temperature set point the VAV box processor shall enter the cooling mode. The controller shall reset the box CFM set point from the minimum ventilation set point to the cooling maximum set point. A velocity sensor shall measure airflow through the terminal unit and compare this to setpoint. The controller shall modulate the damper through PID control action to maintain volume setpoint. The space temperature sensor resets the volume setpoint to maintain the room temperature at the desired setpoint of 75°F (adjustable). Provide adjustable minimum and maximum volume limits.
 - b. On a fall in space temperature equal to the heating temperature set point, the controller shall then modulate the reheat coil as well as reset the supply air volume between the ventilation minimum and the heating maximum set point. The heating volume shall be a function of the heating calculation percentage to minimize the amount of reheat. On a 100% call for heat, the VAV box shall control to the maximum heating velocity set point and the control valve shall be wide open. (Reference Paragraph I)
 - c. Minimum airflow shall modulate from the scheduled control minimum to the scheduled heating maximum to maintain space CO₂ level less than 400 PPM (adjustable) above outside air CO₂ level as measured at the outside air intake of RTU-1. CO₂ differential shall be determined at intervals of not more than 2 minutes using the average readings of the previous period.

2. Unoccupied Mode:
 - a. No cooling shall be permitted.
 - b. Heating shall occur in a similar action to the occupied mode except room temperature shall be 60°F (adjustable).
- F. Fan Coil Unit FC-1:
 1. When space temperature falls below setpoint (adjustable), energize fan and modulate heating water control valve to maintain setpoint.
- G. Fan Coil Unit FC-2:
 1. Occupied Mode:
 - a. The fan shall run continuously in the occupied mode, which shall be determined by a wall mounted occupancy sensor with 3-hour occupied override.
 - b. The fan coil controller shall regulate zone temperature by modulating the heating valve via PID control action to maintain setpoint.
 - c. Cooling is not provided for this unit.
 - d. Outside air and return air dampers shall modulate between 0 and 1400 CFM to maintain space CO₂ level less than 400 PPM above outside air CO₂ level as measured at the outside air intake of RTU-1.
 2. Unoccupied Mode:
 - a. No cooling shall be permitted.
 - b. Outside air shall be closed.
 - c. Heating shall occur in a similar action to the occupied mode except room temperature shall be 55°F (adjustable).
- H. Split System FC-3 matched with CU-1:
 1. When space humidity rises above 60% (adjustable), energize dehumidification mode – condensing unit on, fan coil on, modulate hydronic heating control valve to maintain discharge air temperature equal to space temperature. De-energize the system and close the hydronic heating control valve after space humidity falls below 50% (adjustable).

END OF SECTION 230900

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14. The drawings and specs do not specify if there is a color for the pre-cast concrete items. Is there a color?

Addendum No. 2 includes an Exterior Color Schedule.

15. Is there an approved list of fire alarm manufacturers for this project?

See Addendum No. 2

16. Alternate No. 3 listed in Section 012300 states to “Delete furring and insulation on the interior walls around the Assembly Hall . . . “ Does this include the furring and insulation behind the acoustical panels (Reference Detail D2 on sheet AE513)? Are the acoustical panels also to be deleted under this alternate?

Addendum No. 2 corrects Alternate No. 3 to NOT delete the furring, insulation or gypsum board.

17. Alternate No. 3 also states to delete the furring and insulation in rooms 114, 115, 119, and 121. Walls in these rooms are either 8” CMU with no furring, or 3-5/8” gyp board; neither have insulation. Please clarify what is meant by this portion of Alternate No. 3.

Addendum No. 2 corrects Alternate No. 3 to NOT delete the furring, insulation or gypsum board.

18. Section 014000, paragraph 1.2.D indicates that the Contractor is to engage a testing and inspection firm to provide tests and that the owner will not provide for any testing. However, several sections of the technical specifications state that the owner will engage in the testing firm. Examples include Section 033000, paragraph 3.15.A and Section 042000, paragraph 3.12.A. Please clarify who is to provide the testing.

See Addendum No. 2

19. Request clarification concerning a contradiction between the prints and the specs. In the painting section 099100, paragraph 3.8, interior paint schedule, B. Concrete Unit Masonry calls for 2 coats of Interior semigloss alkyd enamel over block filler, while the prints, sheets AE111 & AE113 call out for the concrete masonry units to be either colored block (Buehner block; parchment integral color or honed) or Block with an accent band (Buehner block accent band Signet Brown). Which is correct?

Addendum No. 2 clarifies this issue.

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20. In specification 107300, Interior Light Shelf System, paragraph 2.04 C describes the finish on aluminum components to be a mill finish. This is the finish it would come with straight from the extrusion process, and is not a clean finish. This finish is subject to tarnishing and staining from such things as handling during installation. Please verify if this is the desired finish for this product or whether you would entertain a change to allow a clear anodize finish which is similar in look to mill finish but will not stain and leave hand marks?

See Addendum No. 2

21. A cast bronze plaque is called out in Specification 101400, paragraph 2.2. Please confirm that the logo on Detail D6/AE212 is for this plaque. If so, what production technique (i.e. – line art, flat relief, bas-relief, flat relief w/ color) is required for the “Guardsmen” and flag? If color is required, how many colors will there be?

See Addendum No. 2

22. Specification 101400, paragraph 2.3 indicates Dimensional Characters are to be furnished “As Indicated”, however, nothing is shown on the plans. Please provide font style and size, text, and mounting location.

See Addendum No. 2 - Allowances.

23. Specification 101400, paragraph 2.4A references “pre-approved equal” for panel signs. Are there any “Pre-Approved Equals” to the manufacturer noted in this specification?

See Addendum No. 2

24. Specification 260533, paragraph 3.3.A.6 references “warning planks”. What are warning planks?

Warning planks are not required, however, traceable (metallic) warning tape over the feeder conduits is required, see details A1 and B1 on sheet ES101.

25. Addendum #1 adds two flag poles. Do the added flag poles have light fixtures the same as the original flag pole that is shown on the drawings?

See the addendum. (2) OE-7 fixtures have been added.

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26. The primary conduit feeding the utility transformer as detailed on sheet ES101, detail A1, shows the conduit size to be 5 inch, schedule 40. Should this be a 6 inch conduit as required by Rocky Mountain Power?

Provide 6-inch conduit.

27. Fixture types “GS-5” and “B” are not listed on the fixture schedule. What are these fixtures”?

See the Addendum for the GS-5 fixture. The fixtures that have a “B” next to them on the site plan are actually OB-2 bollard fixtures.

28. Key Note #1 on sheet EY103 calls for rough-in only with pull strings. Does this note apply only to room 170 or should this note also apply to the other areas where these devices are shown?

This note applies only to room 170 and it only applies to the motions, contact indicators and the security panel “SCP”. The card readers are to be installed as shown.

29. Electrical floor boxes are shown on the 2nd level. How are we to get the number of 2”, 1 ¼”, and ¾” conduit into the floor boxes as shown on sheet ET602, detail A3? Will the concrete be deep enough to make the installation shown?

The deck shall be cut to accommodate the depth of the floor box. Contractor shall coordinate with structural deck and concrete floor installer at those locations.

30. Where is the AV cable schedule that will match the cable type and numbers of cables to the devices as noted on sheet ET601? If conductors are in conduits, what are the sizes of conduits required for the different cables and numbers of cables shown in the schedules?

Cable types are identified in the addendum.

31. We cannot find where a roofing insulation R-value or thickness is specified, can you please advise on a required R-value or total thickness of the Polyisocyanurate insulation.

See Addendum No. 2